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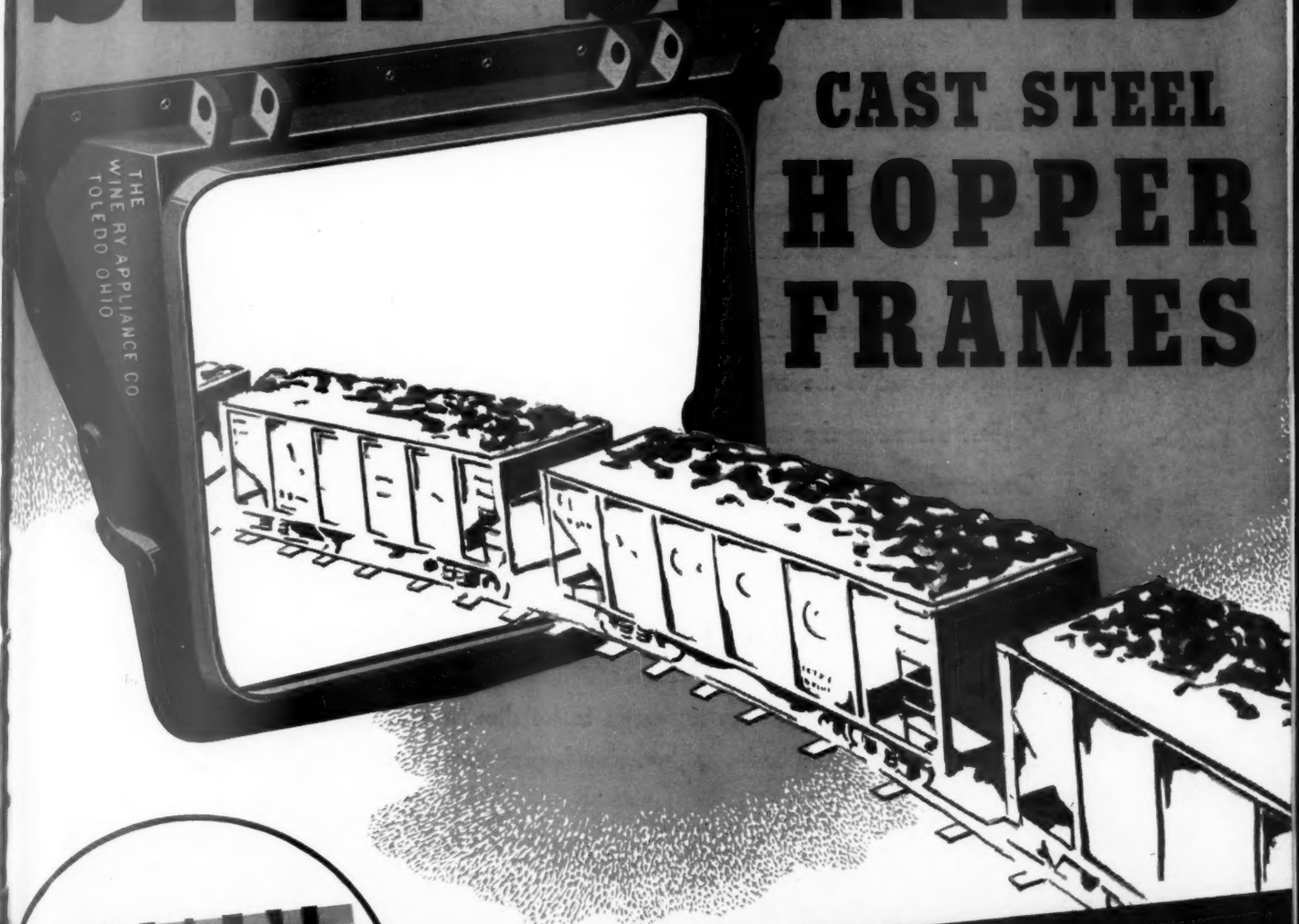

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Again—Conventions in Print

THIS issue, like that of November, 1942, is a "convention in print." The name, indeed, applies even more appropriately this year because the fields of five associations are dealt with in its columns, whereas last year there were but four. The newcomer is the Electrical Section, Engineering Division, Association of American Railroads. This is the second year in which the Coordinated Mechanical Associations have been unable to hold their regular annual meetings because of the pressure of wartime conditions. The high state of the morale of the officers and members of these associations is attested by the fact that for the second year in succession three of the four—the Railway Fuel and Traveling Engineers' Association, the Master Boiler Makers' Association, and the Car Department Officers' Association—have made regular committee assignments for reports on matters of method and practice and on problems of administration. A high percentage of these reports have now been prepared notwithstanding the fact that many of the committees have been handicapped by inability to hold meetings and have had to conduct their business by correspondence. These reports will be placed in the hands of the members of the associations in the customary year books. But the material in them is of interest to a much wider audience than the members alone. In order that the entire field may have the benefit of the work which the officers and committee members have done, at no small sacrifice of personal time and energy, we here present the meat of these reports. The Electrical Section, too, has proceeded constructively with its committee work, even though it does not meet this fall, and six of its reports will be found herein. The fourth coordinated association—the Locomotive Maintenance Officers'—decided against continuing work on committee assignments for this year but sponsored a forum discussion of six timely questions pertinent to present conditions in locomotive shops and engine terminals. In these pages, then, we offer our readers the opportunity to attend "conventions" of five associations which deal with various aspects of their interests.

Nine Reports from

Traveling Engineers' Association

L. E. Dix,
President

J. Duff Smith,
Secretary-Treasurer

"Convention in Print" covers full range of subjects, reports on which will appear later in the year book of the association

For the second year in succession the Railway Fuel and Traveling Engineers' Association has carried on its full year's quota of committee work just as though it were to culminate in the presentation and discussion of the reports at the customary annual meeting. This has been done in the face of increasing difficulties caused by the growing pressure of inadequate manpower and heavy traffic movement.

There are eight committee reports and one paper on the program, which, except one, are abstracted in the pages immediately following. These deal with fuel selection, steam locomotive firing practice, the utilization of steam motive power, and Diesel locomotive operation. There are also reports on the "combustion chain" of the steam locomotive and on refinements in fuel statistics and an individual paper on the recent modification of the AB brake for use in fast-freight service. The report on Gas Turbine Locomotives will appear in a later issue.

Because of the absence of the annual meeting, no election of officers can be held. The officers elected at the annual meeting in 1941, therefore, continued in service. These are President: L. E. Dix, fuel supervisor, T. & P., Dallas, Tex.; vice-presidents: E. E. Ramey, fuel engineer, B. & O., Baltimore, Md.; W. C. Shove, general road foreman of engines, N. Y. N. H. & H., New Haven, Conn.; secretary-treasurer, T. Duff Smith. The members of the Executive Committee are E. Holmquist, master mechanic, C. & N. W., Chicago; A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P., Milwaukee, Wis.; H. W. Sefton, superintendent locomotive and fuel performance, C. C. C. & St. L., Indianapolis, Ind., and W. R. Sugg, general supervisor of air brakes, Mo. Pac., St. Louis, Mo.

A Statement by the President

Adhering to the policy adopted for the duration by the various railroad associations we again suspend our annual convention in the hope that in 1944 the emergency will have passed and we can then get together and reap the benefits which are best produced by contact and discussion of the problems which are confronting us.

Since our last report to the Association we have progressed well into the second year of our total war—a war which is total in all its aspects, none more clearly defined than the demand upon the railroad industry to handle an unprecedented volume of traffic, both freight and passenger. That these demands have been met by the railroads of the United States is attested by the fact that during the past year there has been moved without serious congestion or interruption by far the greatest volume of traffic ever handled in any comparable period and this has been accomplished not with as many or more units of equipment, but actually with less—a lesser number of locomotives and cars in both classes of service.

In these accomplishments the Association has played a vital role as the success of the railroads in meeting every demand made upon them has been due in no small measure to the application of practices and principles advocated by it. With other industry devoted practically one hundred per cent to war production and the manufacture of equipment and materials essential to their proper operation and maintenance reduced to absolute minimum, it has been necessary that the railroads make what they have last to an almost incredible degree and this, too, has been achieved with an amazingly small loss of utility.

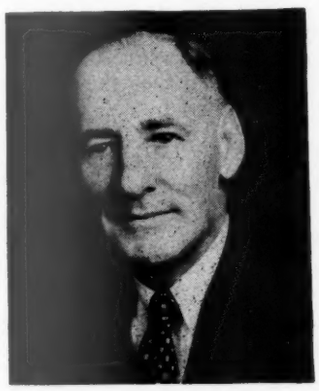
Obviously the gigantic task imposed upon the railroads has created conditions requiring many deviations from past practice. Among these has been greatly increased locomotive mileage in which we have had an important part as there is no single factor more directly essential to this increased service mileage than the proper and economical operation of the locomotive which is the prime objective of our organization.

During the emergency thus far many obstacles have been overcome without serious operating difficulties; many readjustments to unfamiliar types and grades of fuel, both coal and oil, some of which, no doubt, has been inferior to that formerly available and used; the training and educating thousands of new employees in engine service which in itself is a most important step looking to the selection of men who will be qualified some day to carry on, not only on the individual lines but the activities of this and other related associations.

While the burdens of unusual traffic demands have created some conditions which produce unfavorable effects upon fuel performance it is gratifying to note that increases attributable to causes other than the expanded service requirements have been very slight which is testimony to the untiring efforts of the members of the Association to maintain, and even improve the records in this respect notwithstanding the handicaps.

Although our meetings have been suspended and contacts greatly curtailed during the past year while we have done our bit in the paramount task of bringing about a victorious end to the war, the affairs of the Association have received attention, and while being deprived of the advantage of debate and discussion we can all avail ourselves of the many excellent papers appearing herein.

Firing Practice on Coal-Burning Locomotives



W. C. Shove,
Chairman

Getting the fire ready for the trip—Care required in stoker-firing slack coal

In view of the fact that within the past two years it was necessary to bring into locomotive service several thousand inexperienced locomotive firemen, various educational methods have been employed by the railroads. This committee believes that the best results are obtained where student firemen, after being placed on the spare board, are supervised by competent instructing firemen until such time as it was felt they are capable of handling various classes of service alone, a record being kept of each individual fireman, showing the number of trips under supervision before competency is established, and where such records show a specific student fireman is receiving more than the ordinary number of trips, the road foreman or supervisor takes the man in hand in an endeavor to determine if he will ever meet the requirements demanded of a locomotive fireman.

Some benefits have also been derived by placing student firemen on the ash pits a sufficient time for them to become familiar with grate shaking devices, methods of cleaning fires and bedding them down after having been cleaned.

The first essential in line with firing practice is the preparation of the locomotive for service. Firemen should report to the terminal in sufficient time to make a systematic inspection of the fire condition, grates and tool equipment. After trying out the stoker to see that it is operating properly before leaving the terminal, the fire should be maintained in the terminal with the shovel. However, fires can be maintained with the stoker, proper attention being given to the distribution of the coal.

At the time of leaving the terminal, the fire should be in a level, bright condition so there will be no rapid drop in steam pressure. Frequent observation of the fire condition is necessary to know that no banks develop. On stoker-fired locomotives the stoker should be shut off a sufficient length of time for proper inspection of the fuel bed. Firemen should keep a close watch on the steam gauge as well as stack smoke densities. Where the boiler pressure is nearing the maximum, fuel supply should be reduced enough to control the boiler pressure. At such a time it is good policy to inspect the condition of the fuel bed. Following such procedure the fireman should always know definitely the condition of the fire.

At points enroute where stops are made and the fire is building up ash to a depth that will interfere with sufficient air coming through, the grates should be lightly shaken, then or soon after; it is felt by many the proper time to shake grates is after the locomotive has accelerated to the point where the running cutoff has been reached, which gives a better result than shaking while standing and a start made immediately after. Unnecessary use of the fire hook or slice bar should be avoided.

It was felt by one railroad that the showing of the motion picture "Three Atoms" developed by the Baltimore & Ohio a number of years ago, has a very definite effect upon our student firemen.

Within the past several months preparations of fuel on many railroads has not been up to standard and it has been necessary to burn considerably more slack or fines in this coal.

Burning More Slack

The following is taken from a report used by the Reading with very good results:

Intensified efforts are being made to mine enough coal to supply our expanding war efforts and the most conspicuous evidence we see of this is more slack in our bituminous coal. The miners say they cannot produce enough coal to keep the railroads and other war industries going if they have to furnish the same high percentage of lump coal that we formerly received.

Furthermore, in the process of unloading from railroad cars and placing it in coal pockets, the lumps may become separated, going to one side of the pockets with the slack going to another, and by this you can readily see some tenders will be loaded with an excessive amount of slack. Some men, when they get a tank load of this kind of coal, especially on a stoker-fired engine, look for trouble, feeling sure they will have a banked fire.

This is not necessary. The fireman knows that with slack coal he must use more care with the adjustment of the steam jets and in the regulation of the coal feed, and this is the most important single thing in the successful use of slack coal. He must know the condition of the fire at all times by frequent observation so that these adjustments can be made intelligently to prevent or correct irregular feeding or burning of the coal. If he fails to make these adjustments until the steam pressure drops, then it is usually too late—the pile is there.

The fireman must watch all signs of impending trouble, such as the color of exhaust from the slack, steam gauge, the color and action of the flame, the flow of coal

at the crusher and, not the least, he must be alert for signs of stoker defects. These things will give him warning of trouble in time to make the necessary adjustments to jets and feed to prevent the troubles that are sure to follow if not done.

Reports of all delays due to steam or fire trouble indicate that two things cause firemen more trouble than any others, i. e.,

1—Poor distribution of coal, very often due to failure to make adjustments in time.

2—Feeding more coal to the firebox than the engine will burn.

When the steam pressure begins to drop, it is a human tendency to increase the feed of coal. Don't do it. First examine your fire; it may be due to a pile or to a hole in the fire in which case increasing the feed will only make matters worse. What is needed is better distribution and this can be gotten by adjusting jets or feed and often by adding a few scoops of coal by hand. Do not increase the feed until you know by observation that the fire is too light.

See that your fire is clean before leaving the terminal. Get it burning all over and through by use of blower and scoop. Start the stoker carefully and know the condition of your fire at all times. That is very important with any coal—but most important when using slack. Keep the fire level and as light as you can and maintain steam pressure. Do not use a heel or permit banks or piles and keep the fire burning all over. Do not feed more coal than will burn.

Follow the advice herein as being the best way to avoid clinker trouble and steam failure when using slack coal. If you have any doubts about this being the best way, tell your road foreman or traveling fireman. They are more concerned than anyone else in having you get over the road without steam trouble; therefore, it is only common sense to consult them first if you have any doubts, or trouble with your fire.

Please keep in mind that war conditions require for the present that we use more slack coal than formerly; this is something beyond our control to remedy. Let us use care so that we can burn it successfully, thus saving ourselves hard labor and avoiding train delays.

If you note any stoker defects, or have experienced any irregular operation, be sure to report it on the work report. A good stoker makes the job easier.

The report was signed by W. C. Shove (chairman), general road foreman of engines, N. Y., N. H. & H.; W. E. Beaver, general road foreman of engines, Southern; O. L. Dean, mechanical superintendent, Bangor & Aroostook; C. Harding, road foreman engines, L. & N. E.; W. E. Small, B. & M.; F. X. Jones, supervisor fuel and locomotive operation, Erie; W. D. Quarles, general mechanical instructor, A. C. L.; J. H. Simmons, N. Y. C.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; S. M. Roth, supervisor locomotive performance, Western Maryland; G. B. Curtis, assistant road foreman engines, R. F. & P.; W. R. Sugg, general supervisor air brakes, Mo. Pac.; W. E. Sample, assistant superintendent fuel conservation, B. & O., and A. Baxter, general road foreman equipment, D. & R. G. W.

Training Firemen for Oil-Burning Steam Locomotives

E. G. Sanders,
Chairman

Western oil-burning roads find new firemen hard to get—Inexperienced supervision handicaps their training

The unprecedented volume of traffic now being handled by all railroads due to the war has necessitated employing a great many inexperienced men for locomotive firemen. A large number of the experienced firemen have enlisted or been drafted into the armed forces, and in addition, nearly all of the experienced firemen who have been promoted to engineers are now running locomotives. All of this has resulted in having to man the locomotives with inexperienced firemen.

On the oil-burning railroads traversing the sparsely settled desert country in the west and southwest, it has been difficult to get men to accept employment as firemen due to the shortage of housing accommodations. With the serious shortage of firemen existing in this part of the country, the training of student firemen has been a difficult problem. Many instances have been reported where a student fireman would make a trip with a fireman performing his first pay trip after being qualified. Obviously, the student fireman would have little opportunity to learn anything about the correct method of firing a locomotive.

Previous to the war, the railroads were able to select the men hired as new firemen. It was the usual practice to require that an applicant for the position of fireman should have at least a high-school education, and whenever possible, men were selected who had previous experience working in locomotive shops and roundhouses. Under present war conditions, the problem confronting the oil-burning railroads in the west and southwest is to be able to employ a sufficient number of firemen to man the locomotives. Education and other desirable qualifications are of secondary importance.

Fuel supervisors, road foremen of engines, air-brake supervisors and other traveling supervisors who ride locomotives have a very great responsibility training and instructing new firemen. It is important that the men selected for supervisors be well qualified to train and instruct firemen.

Supervisors should ever keep in mind the fact that a great many of the new firemen have not been properly instructed or received adequate training before being assigned as firemen. It will be found that many of them, through no fault of their own, will have acquired incorrect methods and practices of firing oil burning locomotives. It requires a great deal of patience and effort on the part of the supervisors to train and instruct firemen who have learned to fire improperly.

A great many of the new firemen will remain in railroad service as firemen after the present war emergency is over. On how these men learn to fire a locomotive in the early months of their employment depends whether they become good or poor firemen, and in later years whether they are good or poor enginemen.

Under present conditions, it is not possible to provide enough supervision to train new firemen intensively to the extent that would be desirable. Many of the younger supervisors have had very little experience in supervisory work. Much coaching is required on the part of the master mechanic and the older supervisors. It is essential that young or inexperienced supervisors be trained how to instruct new firemen. It is the duty of the master mechanic and senior supervisors to give such necessary training and instructions to the new supervisors before they are assigned to train and instruct new firemen. Knowing how to fire an oil-burning locomotive properly does not necessarily mean that a man will make a good supervisor to train new firemen. Very often the best fireman on a division will make a poor supervisor, for the reason that he does not have the ability to impart the knowledge he has to the new men. Too much care cannot be exercised in the selection and training of supervisors.

Members of this Association from oil burning railroads are cordially invited to comment on this report and it is hoped that they will advise how the training of new firemen has been handled on their railroads.

The report was signed by E. G. Sanders (chairman), fuel conservation engineer, A. T. & S. F.

Utilization of Steam Motive Power

A. A. Raymond,
Chairman

A discussion of the problems of servicing locomotives on long runs without undue delay

A study of the use of locomotives can perhaps be made along the following lines:

1.—Will the machinery of a locomotive stand up under intensive utilization.

2.—Continuing a steam locomotive in service requires a renewal of the water and coal supply or larger tenders, and dumping of ash pans or some means of increasing ash pan capacity.

3.—Will present operating conditions permit or allow the standing time that is necessary to take coal, water and dump ash pans or should facilities be provided even at considerable cost to reduce this time to a minimum.

Mechanical Reliability

The literature of the Railway Fuel and Traveling Engineers Association, the reports of the Association of American Railroads Mechanical Division, The Railway Age and many other reports, talks before Railroad Clubs, etc., show that the modern locomotive has great reliability and that high mileage, so far as the machine is concerned, can be expected. This, it appears, follows experience with modern machinery which has become increasingly reliable.

Attached is a chart of the utilization of locomotives on all Class One railroads and it will be observed that the use of passenger engines is increasing steadily with freight showing some increase and switch little change.

Engine failures on long through runs, that is, per cent cut outs, varies, but in general the reliability is high with 4 per cent on one large system.

So it seems reasonable to assume that the locomotive, if properly maintained, can and will supply even greater percentage of utilization if other factors can be arranged to keep refueling delay, for instance, at a proper figure.

Servicing Facilities

Water

Where a passenger locomotive uses possibly 100 gallons per mile and a freight locomotive 200, water builds up in weight so rapidly that for long through runs it seems necessary either to scoop water or to provide large enough water plugs *at regular stops* so that the tender or auxiliary tank can be filled in not over three minutes during the time of a regular station stop or while changing crews. Thus a 100-mile division passenger run requires at least 10,000 gallons weighing 83,000 lb. and the freight run will use 20,000 gallons weighing 166,000 lb. which, with a necessary reserve of 5,000 gallons would seem to indicate that 10,000 gallons of water must be taken in three minutes by a passenger locomotive every 100 miles with correspondingly larger freight tenders or more stops. If division non-stop runs of 150 or 200 miles are to be made, of course the tender must be proportionately larger.

Coal

Assuming a passenger engine making 20 miles per ton and a freight 10 miles per ton, a 900-mile run can

be made with 45 tons. Adding a bad weather or train-late margin of about 70 per cent we get a total of 75 tons. The decision must be made as to how often a coal stop can be made, where it can be made and what time will be allowed.

Forty-two tons can easily be put on a locomotive tender in 75 seconds with a modern coaling facility, but the time slowing down and accelerating may stretch out the lost time to 7 or 8 minutes, if this is a special stop.

If coal can be taken at a regular stop or at a crew-change point the time element does not enter. A coaling plant in a passenger station is not desirable (except small ones for emergency coaling). Furthermore, a plant large enough and covering enough track to coal several trains in a few minutes would be very expensive; a tender that will only require one stop seems desirable.

Freight trains on through runs should have an auxiliary coaling plant on at least two tracks where a train not requiring switching can be coaled while cabooses or crews are being changed and where locomotives can readily receive coal and water if the train requires switching. In the latter case the facility should be located so that the locomotive will not interfere with yard movements.

Ash Pans

It is found in through passenger service that ash pans of ordinary capacity require dumping at about 250 miles. The dumping and cleaning take considerable time. It is recommended that serious study be given to using the space left as coal is used up in the larger tender through a series of conveyors, as an auxiliary of the main ash pans. In this case it would be possible to run long distances without stopping for ash-pan cleaning.

This again is primarily a matter of time and secondarily of place. Passenger stations are hardly a good place to dump pans, although undoubtedly an ash handling plant could be made practically dustless (although expensive).

The above discussion has all referred to passenger and freight service, but substantial savings can be made if switch engines are worked more intensively and this can be done by providing several auxiliary coal, water and ash handling facilities near where the engine can be stopped while the crew eats lunch. Such location, to be of value, requires careful study and with a proper control of smoke and ashes can be used in most places without causing trouble in the neighborhood.

The report was signed by A. A. Raymond (chairman), superintendent fuel and locomotive performance, N. Y. C.

Front Ends, Grates, Arches and Ash Pans

J. R. Jackson,
Chairman

The report suggests need of a study of gas flow to determine tube sizes which will not plug

It has been and is generally accepted practice in making evaporative and efficiency tests of locomotive boilers to install U-tube draft gages in the smoke box, superheater-header, combustion chamber, fire box and pan, possibly providing two or more gages in the smoke box to register ahead and behind netting or plates and in the fire box under and over the arch. The records of these gages are in inches of water, one inch being equivalent to a pressure of 0.036 lb. per sq. in. In the combustion train of a conventionally drafted steam locomotive boiler, the drafts, with the possible exception of that in the pan of a coal-burning locomotive, are all less than atmospheric pressure or vacuum, ranging from maximum vacuum in the smoke box and progressively increasing to atmospheric pressure at the air openings into the pan. The difference in draft pressure between points in the path of flow through the fire box and boiler, temperature of the gases, area of the gas passages and resistance in the path of flow, determines the volume of flow at that point.

The products of combustion coming through the fire bed of a coal-burning locomotive and from the combustion zone of an oil- or pulverized-coal-burning locomotive will take the path of least resistance in their passage through the fire box and into and through the flues and tubes headed for the smoke box. The temperature, direction and rate of flow of heat through the fire box, flues and tubes is what makes for free steaming and the continuance of this condition over long periods of time is what makes for satisfactory and economical operation. Experience has indicated that the distribution of the flow of heat through the boiler is essential to economical and trouble-free operation and that the provision and maintenance of a relatively close balance between the component parts of the combustion train is the secret of satisfactory road performance.

The energy in the exhaust to atmosphere from a steam locomotive is very considerably more than sufficient to draft the boiler. Over drafting is decidedly a possibility with a front-end arrangement having relatively large jet surface areas, stack areas and high volumetric efficiency for the movement of gases through the boiler. A condition of excessive draft is as bad as insufficient draft as regards development of boiler power on the road. The over-drafted condition, however, has the disadvantage of excessive fuel consumption without adequate return in water evaporated or steam superheated, whereas with the under-drafted condition it is impossible to burn sufficient coal to develop the desired power. The over-drafted condition obviously results in the induction of excessive air for combustion, the lowering of the temperature of the gases and excessive volume and rate of flow over the evaporating surfaces. No inconsiderable portion

of the energy of the exhaust jet is utilized to properly elevate the products of combustion above the train in motion and there is a practical limit to relatively large stack areas in combination with the conventional nozzle design beyond which it is inadvisable to go for the reason of the lower velocity of discharge which makes for trailing smoke.

The heavy traffic and limited power situation on the railroads during the past year has made it necessary to utilize available locomotives to the utmost and emphasizes the fact that the limiting factor on coal-burning locomotive availability from a servicing standpoint is the necessity for periodically blowing the flues. Twenty years ago the necessity for both frequently washing boilers and blowing flues kept locomotives in terminals for extended periods but the improvement in boiler waters and the general practice of conditioning boilers by terminal and on-line blowing has practically eliminated the water problem as it effects utilization, whereas the necessity for holding locomotives for blowing flues continues to be the limiting factor as to the mileage that can be made before engine-house attention and as to the time necessary to service locomotives at terminals.

Much is heard about cinder cutting of units and flues on coal-burning locomotives, which condition, of course, is related to gas velocities and the character of the fuel supply. As the gas area through the flues is decreased progressively by stoppage, velocity and cinder cutting increase. Equalized gas flow through flues and tubes is important and extreme draft fluctuations are to be avoided.

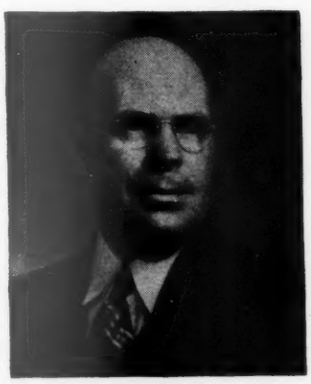
In the realm of increased steam locomotive utilization, particularly coal-burning locomotives using grades of coal which are regularly available in different parts of the country, a question relating to the proportion of evaporative and superheating surfaces and gas area restrictions in the original design presents itself. The question is should not the tubes, flues and superheater unit be proportioned to insure adequate over-all boiler capacity and efficiency over a longer period of operation rather than ideal efficiencies over shorter periods of operation? In other words, would it not be better to have all of a lesser number of flues and tubes kept open all of the time rather than experience flue stoppage in flues of restricted gas area after relatively short service?

A study of the paths and velocities of air intake and heat flow through a locomotive boiler should add materially to the knowledge of drafting for both economy and availability. With the instrumentation available after the war it should be a possibility in the field of research to study this temperature-flow relationship which could not only be expected to yield valuable information in drafting the boiler from the standpoint of establishing the most economical combustion-train relationship for a given fuel but also to throw light on the practical problems of cinder cutting and control of slag formation.

The report was signed by J. R. Jackson (chairman), engineer tests, Mo. Pac.; H. D. Green, Nor. Pac.; H. L. Malette, road foreman of equipment, St. L.-S. F.; A. A. Raymond, superintendent fuel and locomotive performance, N. Y. C.; W. E. Small, B. & M.; S. R. Tilbury, fuel supervisor, A. T. & S. F.; L. W. Withrow, C. & O., and E. G. Young, University of Illinois.

The Road Foreman and Diesel Locomotives

Enginemen must be taught correct starting and transition procedure to protect the locomotive against damage



W. D. Quarles,
Chairman

In cases where our Diesel operations are pooled and an engineman operating a freight Diesel is called to fill a vacancy on one of our passenger locomotives, it is necessary that he thoroughly understand the difference in the operation of the controls on the two type of locomotives. He may carelessly subject the locomotive to harmful abuse that will, if not at the instant, set up a weak condition which on a later date may cause a failure and possible delay to a train.

The road foreman of engines should continuously keep the engine crews conscious of knowing and understanding the fundamental operation of Diesel-electric locomotives. The fuel-oil tanks, lube-oil tanks, engine cooling systems and the boiler-water tanks should be known to have sufficient supply for the trip ahead. In starting the diesel engine the proper procedure should be followed regardless of time element. The present instructions as issued by the manufacturer in regards to starting the engines is to "Test for cylinder liquid accumulation with test valves open and isolation switch in 'start' position. Rotate the engine once or twice by hand using the engine turning bar. If liquid is noted at test valve do not start the engine until the cause of the discharge is removed."

It has been the practice on most roads to open the cylinder test valves and then push the engine "start" button and thereby rotate the engine to test for liquid accumulation. The current flow may reach a value of 1,400 amperes at the instant the starting contactors close and if a good contact is not made, or the "start" button is jabbed, the current flow is interrupted and high amperage will cause destructive arcing at the contactors, shortening their life and even welding the contactors closed. Instill in your men the necessity for making good contact to prevent arcing and consequent damage to contactors and interlocks. After the test valves are

closed it is important that the auxiliary generator disconnect switches in the low-voltage cabinets of the engine that is running be opened in order to prevent blowing of the battery charging fuse. The next procedure is to start the fuel pump and after pressure is built up as indicated on the gauge, press the "start" button and hold until the engine speed recorded on the tachometer reaches 150 to 200 revolutions per minute. By holding the starting contactors closed until the engine starts and runs, the starting current will reduce and, when the contactors do open, is of such value that arcing is minimized.

After the diesel engine has been started the main bearing and piston cooling lubricating-oil gauges must be observed. An inspection should be made at this point to determine if the contacts on the ground protective relay are closed. It has been found that thin relay 'kicks out' when the main generators are motorized in starting the engine at times due to grounds on the low-voltage system.

Before the Diesel locomotive leaves the hostler's track at the initial terminal a thorough brake test should be made to determine the proper setting of the feed valve and that the brake system reacts in accordance with the operation of the independent and automatic brake valves. The initial test should be made with the Diesel units alone to test for leakage and proper operation due to the possibility of crossing of pipes between units. If by chance the actuating and the independent application and release pipes were crossed it would result in possible damage to the wheels. When the brakes are set with the automatic brake valve a test should be made to accomplish an independent release.

The road foreman should impress upon the enginemen the necessity of making a thorough inspection of the running gear so that improper shoe clearance or fouled brake rigging may be corrected at terminals and thus avoid delays on the road.

The engineman controls the speed of the Diesel engines with the cab throttle or controller. The actual control of the engine speed is, of course, effected by a governor mounted on the front of the engine and what the engineman actually controls is the governor demand. On a switching locomotive, using only one Diesel engine this demand is accomplished by a system of rods and levers connected between the cab controller and the governor. On passenger, freight and transfer locomotives, where several engines in more than one unit must be controlled by one throttle handle it is out of the question to use the same system of rods and levers. Instead the several governors are controlled simultaneously by the electro-pneumatic governor control, more commonly called the "grasshopper."

This device mounted on the engine next to the governor consists of four air cylinders and a system of levers which transfers the movement of the air cylinders to the governor. The air cylinders are actuated by magnet valves, one mounted on top of each cylinder, and the cab throttle handle moves a contact surface that connects the magnet valves in combinations to give the desired Diesel engine speed to correspond to the position of the cab throttle. The wiring to these magnet valves runs the entire length of the locomotive.

Most Diesel-electric locomotives use the "soft start," which means that the exciting current of the main generator is at the lowest value. This exciting current is controlled by a load regulator, a device that is operated by the engine governor. In starting a heavy train the engineman advances his throttle from idle position to Run 4, pausing a matter of two to three seconds between notches. This pause is necessary since each notch above Run 1 causes the Diesel-engine speed to increase in steps of 75 r.p.m. and time must be allowed for the engine to assume the new speed before advancing to next notch. During this advance the load regulator begins to move from minimum excitation to maximum excitation. This movement requires from 12 to 25 seconds, depending on the type of load regulator used, and the train should begin to move. At the start the electrical connections between the main generator and the traction motors are such as to give the traction motors a maximum amount and thus provide the heavy torque of turning force necessary to start the train. The engineer then advances his cab throttle, speeding up the Diesel engines, but the pause between each notch should be from 4 to 6 seconds. The load regulator, once the load has been applied to the Diesel engine, has a definite function of protecting the engine against over-loading. Hence the pause between throttle positions is increased to allow this device to function.

The practice on most roads, when the locomotive is standing at terminals and the engineman is not in the seat, is to leave the throttle in idle position, the reverser in neutral with the handle removed and the generator field switch out. This is to guard against leaving power applied to the motors while standing and prevent damage to equipment as well as to guard against the train moving off if the brakes were released and controls positioned for power.

It has been found at different times that the engineman, on preparing to start train, overlooked the fact that the generator field switch was out and opened the throttle to Run 4 with no result. He then noted that this switch was out and there have been instances of the engineman pushing in the switch with the throttle still in Run 4. By this time the load regulator was either in maximum field excitation or approaching it, and under these conditions power is suddenly applied with considerable force, enough so as to cause damage to gearing, electrical equipment and the train itself. The crews should be instructed that if such a condition is noted, the throttle must be closed off at proper time interval to idle position, the switch closed and ample time allowed to permit the load regulator to return to minimum field excitation before again opening the throttle. This should be accomplished in from 12 to 25 seconds depending on the type load regulator involved.

As the train speed increases, it reaches a point where the turning effort of the traction motors balances with the current flowing and in order to get more speed it is necessary to change the electrical connections. This changing of the connections is called transition. On passenger locomotives this function is automatic while on freight locomotives it is done by the engineman. During transition a lot of things take place within a very short space of time. The transition relay closes and in so doing causes the main generator shunt field contactors to open. The shunt field contactor opening causes the battery field contactor to open and when this contactor opens it unloads the main generator and also closes a circuit to the time delay relay. After a split second the time delay relay closes and establishes a circuit that closes the first parallel contactor. Interlocks on this contactor open and that drops out the series contactor. When the series contactor opens it sets up a circuit which closes the second parallel contactor. The second parallel contactor opens interlocks that de-energize the transition relay which now opens and allows shunt and battery field contactors to close and load up the main generator again. In case of failure of any of these various steps

transition stops and the power plant remains off the line until the trouble is found and corrected. This is a safety feature preventing damage to the generator and traction motors through wrong electrical connections. A knowledge of this sequence enables the crew to quickly locate and remedy the defect, returning the power plant to the line.

The position of the load regulator should be noted from time to time while locomotive is under way as a check on proper loading. For istance, if load regulator arm is all the way over in maximum field excitation, and the load indicator mounted adjacent to the governor below the grasshopper shows that the engine is only partly loaded, with its speed maximum, then there is definitely electrical trouble. A check should be made to determine if the shut-field and battery-field contactors are closed. If they are then check the 60-amp. battery field fuse or the load regulator itself for brush trouble or bad electrical connection. Also check for auxiliary-generator battery-charging fuse blown, loose belts on generator or a generally weak battery. If the contactors mentioned are open look for bad electrical conection at the ground relay contacts, wheel-slip relay contacts, or a starting contactor interlock open or making poor contact. The trouble can usually be located at one of these points.

On the other hand, if the load regulator is in minimum excitation area and the load indicator shows an overload, the trouble is mechanical. Check the engine for proper fuel supply, an injector not firing or mis-firing, poor compression due to broken or stuck valves, or blow-by at piston rings.

Lube-oil and fuel-oil pressure gauges should be observed. Likewise the lube-oil tanks should be checked to watch for fuel oil or water dilution. Such dilution going un-noticed can result in engine damage that would cause not only a loss of power through losing that power plant but may result in a locomotive being tied up at maintenance point for extensive repairs. Traction-motor blower-fan belts should also be checked en route. A few minutes spent periodically while the locomotive is running will pay big dividends in preventing costly repairs and lost mileage.

The report was signed by W. D. Quarles (chairman), general mechanical instructor, A.C.L.

Refinements in Fuel Statistics Move Ahead

Committee on Fuel Records and Statistics collaborates with committee on statistics of the accounting division

E. E. Ramey,
Chairman

The Committee on Fuel Records and Statistics reported on two questions on which it has been collaborating with the Committee on Statistics of the Accounting Division, Association of American Railroads. The first has to do with the incongruity of the figures for the quantities of fuel and power used, respectively, by the several types of motive power in road service as reported by the I.C.C. Bureau of Transport Economics and Statistics on Statement No. M-230 (OS-E), and the car-miles reported by the type of trains based on the kind of fuel burned by the principal locomotive as reported on Statement No. M-213 (OS-B). The second relates to the use of "statistical equivalence" of the respective fuels based on relative results obtained in service in the production of gross ton-miles, passenger-train car miles and switch-engine hours in establishing the factors to be applied in converting other fuels and power to terms of pounds of coal, rather than the thermal equivalents of the respective fuels.

With respect to the first subject, the committee pointed out that where locomotives burning one type of fuel perform helper service on trains hauled by locomotives using another type of fuel, the fuel used in helper service is accumulated against the type of service performed by principal locomotives burning that type of fuel. Thus, in a case cited in the report, the performance figure per passenger-train car-miles moved in trains hauled by Diesel locomotives was 0.288 gallon, based on the present method of reporting car-miles and fuel consumption, whereas when the fuel consumed by steam locomotives helping trains hauled by Diesel-electric locomotives was added, the unit consumption increased to an oil equivalent of 0.313 gallon. The figures based on the present method of reporting are 8 per cent lower than if the coal used in helper service is charged to the train-service hauled by Diesel locomotives and the unit fuel consumption in steam-train service is unduly high by having the coal used in Diesel-helper service charged against steam-train operation.

The committee of the Railway Fuel and Traveling Engineers' Association also took up with the Committee on Statistics of the Accounting Division the question of adding an item to the OS-E form to provide for reporting equated pounds of coal (all road passenger service) per 1,000 gross ton-miles, including locomotives and tenders. It further proposed the addition of items to Forms OS-A and OS-E to provide for the entry of the Diesel locomotive in freight service.

The Committee on Statistics of the Accounting Division expressed the opinion that some suitable adjustments to overcome the incongruity of the unit fuel consumption figures when a different type of fuel is used by the principal and helper locomotives should be made through the medium of car-miles or ton-miles, or in the quantities of coal in computing the averages so as to reflect a true average pound of coal per 1,000 gross ton-

miles and per passenger car-mile for road freight and passenger service, respectively. This committee also concurred in the recommendation of the Railway Fuel and Traveling Engineers' Association with respect to the amplification of Form OS-E to provide for equated pounds of fuel for all road passenger service per 1,000 gross ton-miles, including locomotive and tender, and in the suggested amplification of Forms OS-A and OS-E to provide for separate fuel performance results for Diesel locomotives in freight service. It recommended, however, that the changes in forms required to carry out these two proposals be deferred in view of the existing conditions until such time as the I.C.C. Bureau of Transport Economics and Statistics undertakes other substantial revisions of the OS forms.

In its report on the matter of fuel equivalents the Committee on Statistics of the Accounting Division referred to Note E on Form OS-E, which relates to the equating formula, as follows: "These instructions are understood to mean that the formula employed must recognize the existing facts and the values must be established in such a way that the service conditions, relative effectiveness of fuel, and local conditions peculiar to each railroad will be reflected in the equivalents used by that railroad.

"The consensus of your committee is that the fuel performance statistics to be of real value must reflect the facts peculiar to the types of fuel or power used and that fuel or power should be converted to a coal equivalent by the application of a true equation factor, which comprehends the relative effectiveness of the different types of fuel or power used as related to coal under similar service conditions on the reporting railroad.

"On behalf of the I.C.C. Bureau of Transport Economics and Statistics, Mr. Vallandingham, who was present during the discussion of the foregoing, agreed to insert an appropriate footnote to Schedule 571, Consumption of fuel by motive-power units, of Annual Report Form A, providing for showing the ratios used in converting other fuel to a ton of coal."

The report of the Railway Fuel and Traveling Engineers' Association committee concludes as follows: "With the support of the action here reported which has been taken by the highest statistical authority that the American Railroads have established, acting officially through regular organization channels, it is our hope that the comparatively small proportion of the companies that continue to equate their fuels and power to the coal equivalent value upon the unmodified basis of the relative thermal (B.t.u.) contents may be influenced to modify their views and practice to conform to the procedure that is being more generally followed.

The report was signed by E. E. Ramey (chairman), superintendent fuel conservation, B. & O.; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; J. G. Crawford, fuel engineer, C. B. & Q.; J. R. Jackson, engineer tests, Mo. Pac.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; E. G. Sanders, fuel conservation engineer, A. T. & S. F.; W. R. Sugg, general supervisor air brakes, Mo. Pac.; W. J. Tapp, superintendent fuel conservation, D. & R. G. W.; and R. J. Tucker, assistant to fuel supervisor, C. & O.

Braking of Fast Freight Trains

Paper describes the new AB-1-B equipment which adapts the AB freight brake to the control of high-speed manifest trains up to 60 cars in length

By L. K. Sillcox

Senior Vice-President, The New York Air Brake Company

L. K. Sillcox

War conditions and modern competition are making it more than ever necessary that freight as well as passengers be moved at greater speeds. After careful study of the requirements for a satisfactory brake equipment for high-speed freight service, it was found desirable to develop such an equipment around the standard AB equipment as a basis.

The AB-1-B brake equipment is intended for use on freight cars equipped with high-speed trucks, such cars to be hauled in solid high-speed manifest trains up to 60 cars in length. Typical cars for this class of service would be of the refrigerator, specially assigned box cars, and container car types. Although cars having this equipment can be and are being used in passenger trains, I wish to emphasize that cars so equipped are primarily intended for use in freight trains. When used in passenger trains, AB-1-B equipped cars should be located at the head end of the train.

Cars equipped with the AB-1-B equipment can be used in standard freight service as well as in high-speed freight service. They have a signal line running throughout and air in this line is utilized to condition the equipment for high-speed service, while the absence of air in the signal line automatically conditions the equipment for use in standard freight service. The presence of signal-line air automatically adjusts the control valve to provide a direct build-up of brake cylinder pressure during an emergency application at a rate substantially the same as with passenger equipments. Operating in standard freight service where no signal line air is available, the control valve is automatically adjusted to provide the standard three-stage development of brake-cylinder pressure during emergency applications of the AB freight brake equipment.

The principal valve is known as the AB-1-B control valve and, in addition to the service and emergency portions common to the AB pipe bracket and emergency portion, a selector valve portion which is mounted on the filling piece, and a safety valve similar to that used with the D-22 control valves for passenger service. The safety valve is mounted on the selector valve portion and protects against brake cylinder pressure exceeding nominally 60 lb. during service applications. The signal line connections is made to the filling piece.

The service and emergency portions function the same as they do in the standard AB equipment, with the exception that the functioning of the selector valve portion has an influence upon the functioning of the emergency portion during emergency applications when used in high-speed freight service.

It has been previously mentioned that the safety valve is similar to the one used with the D-22 control valve. This is true as far as construction is concerned, but this statement must not be taken to mean that a safety valve from D-22 control valve can be used satisfactorily on the AB-1-B control valve. The range of the valve is different and safety valves intended for use on AB-1-B valves are marked on top of the hood with the letters "FRT" while those for D-22 control valves are marked "PASS" in a similar location.

Referring to the diagrammatic assembly of the AB-1-B control valve, Plate 1, it will be observed that the selector-valve portion consists of two diaphragm-actuated spring-loaded check valves *174* and *174a*. The selector valve portion is connected to the control valve proper by three passages *c10*, *c* and *b9*, and to the car signal line by passage *S*. Chamber *R* beneath the upper diaphragm is connected to brake pipe air by passage *b9* and check valve *174a* is forced from its seat by the deflection of the diaphragm as long as brake-pipe air, in excess of approximately 15 lb. per sq. in., is present in chamber *R*. Chamber *P* on the face of the lower diaphragm is subject to signal-line air when available and the diaphragm is, therefore, deflected to unseat check valve *174*. Check valve *174a* is located between passage *c* and the safety valve; check valve *174* interrupts passages *c10* and *c*.

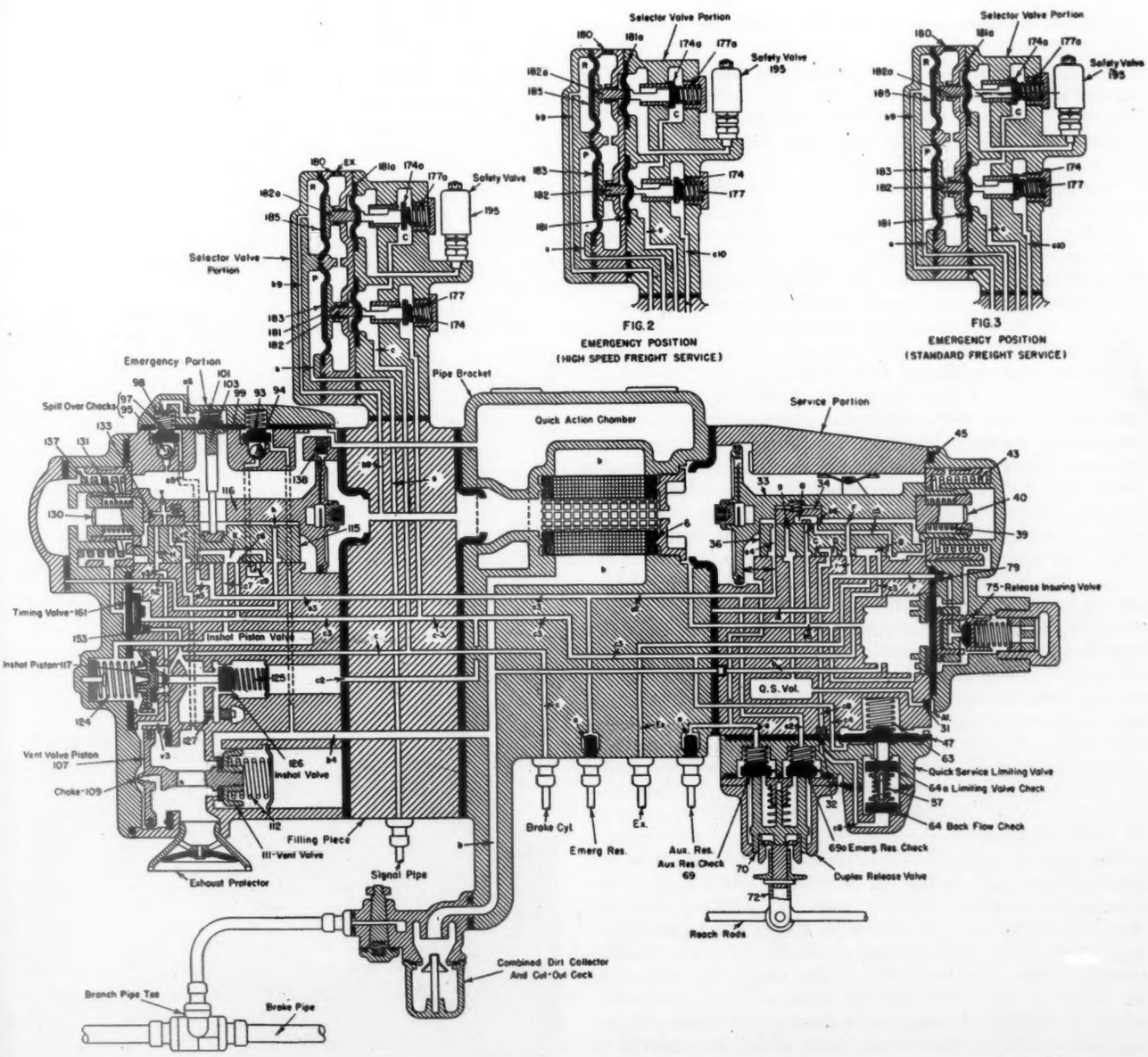
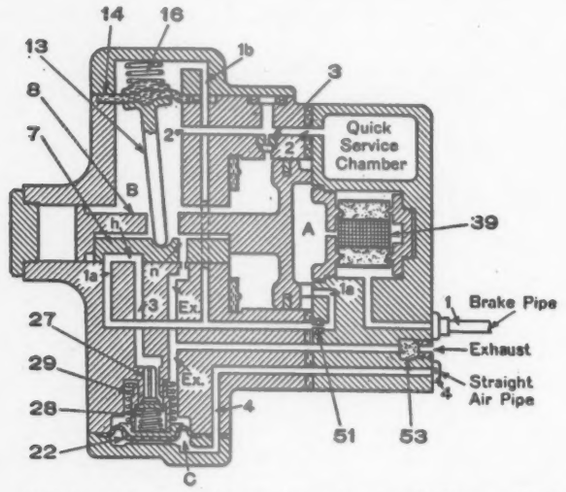


FIG. 2
EMERGENCY POSITION
(HIGH SPEED FREIGHT SERVICE)

FIG. 3
EMERGENCY POSITION
(STANDARD FREIGHT SERVICE)

AB-1-B valve for high-speed freight service (release position)

Operating in high-speed freight service and during a service brake application, the development of brake-cylinder pressure is the same as for the standard AB equipment, except that the safety valve is connected to



A-2-A continuous quick-service valve (application position)

the brake-cylinder passage by unseated check valve *174a* in the selector-valve portion; that is, auxiliary-reservoir air flows through the service portion slide valve to passages *c3* and *c2*, past unseated inshot valve *126* to passage *c* and brake cylinder.

Operating in high-speed freight service and during an emergency brake application, the development of brake-cylinder pressure is direct and not in three stages as is the case with emergency brake cylinder pressure development with the standard AB freight brake equipment. Combined emergency and auxiliary reservoir air in passage *c3* flows through passage *c10* and past unseated check valve *174* in the selector valve portion to passage *c* and the brake cylinder, thus by-passing the delay choke *127* and timing valve *161* which account for the second and third stages respectively for standard freight-service emergency brake-cylinder development. During emergency applications and because of the brake-pipe pressure being reduced to zero in chamber *R* of the selector-valve portion, check valve *174a* is forced to its seat by the tension of spring *177a*, thereby isolating the safety valve from the brake-cylinder passage *c*.

Because it is intended that these AB-1B equipped cars are to be associated together in high-speed freight trains, the use of an A-2-A continuous quick-service valve to speed up the time of obtaining a full service reduction throughout the train is recommended. This valve, although similar in construction to those used in high-speed passenger service, is differently calibrated. It is not vitally necessary inasmuch as the initial transmission of the brake application is accomplished very effectively by the normal quick service function of the AB-1-B control valve, but it materially increases the subsequent rate of brake application throughout all parts of the train.

The A-2-A continuous quick-service valve is connected to the brake pipe as shown in Plate 2. Referring to the diagrammatic sketch of the valve, it will be observed that it consists of a quick-service chamber, a piston-operated slide valve, spring-loaded check valve and brake-pipe strainer. On one side of the piston is brake-pipe air while on the other side is quick-service-chamber air which is supplied through a charging choke during charging and releasing operations. The slide valve serves to connect brake-pipe volume and quick-service-chamber volume with the atmosphere during service applications.

During charging and releasing operations brake-pipe air flows through the strainer *39* to chamber *A* on the face of the piston from where it flows at a restricted rate through choke *3* to charge the slide-valve chamber and quick-service chamber. Owing to the restricted charging rate through choke *3* and the volume of the quick-service chamber, slide-valve chamber *B* will charge more slowly than chamber *A*, thus insuring that the piston will be held in release position during this operation. As the pressures on both sides of the piston become balanced the piston will remain in release of its own inertia.

When a service rate of reduction is initiated at the brake valve, a reduction of pressure takes place in chamber *A* and the piston and slide valve after an approximate differential of one-half pound is obtained, moves to application position as shown in the diagrammatic sketch. The slide valve then connects brake-pipe air in chamber *A* with the atmosphere by way of passage *1a*, choke *51*, passage *3* and unseated check valve *27*. Quick-service-chamber air is also connected to atmosphere by the safety valve through port *n* and port *EX*. Choke *51* and the exhaust port in the slide-valve seat are calibrated to permit the quick-service-chamber pressure to reduce faster than brake-pipe pressure and as soon as the former reduces to one-half pound less than the latter, the piston will automatically reassume release position. As the brake-pipe reduction continues, the continuous quick-service valve repeats this movement each time reducing the brake-pipe pressure a small amount and thus continuously propagating the brake-pipe reduction from car to car. For split or successive brake-pipe reductions, the continuous quick-service valve operates during each reduction to perform the quick-service function as described. It, therefore, appreciably reduces the time required to obtain service brake application throughout a train.

The AB-1-B freight-car brake equipment, in addition to the devices already described, includes the double compartment reservoir, brake cylinder, retaining valve, brake-pipe cutout cocks, combined dirt collector and cutout cock, branch pipe tee, hoses and couplings which are common to the standard AB freight-car brake equipment. Also included is a standard signal line consisting of cutout cocks, hoses and couplings. A number of AB-1-B equipped cars which are at the present time being built for service in troop trains to relieve the standard Pullman car shortage are also equipped with slack adjusters, although fundamental schedules do not make them mandatory.

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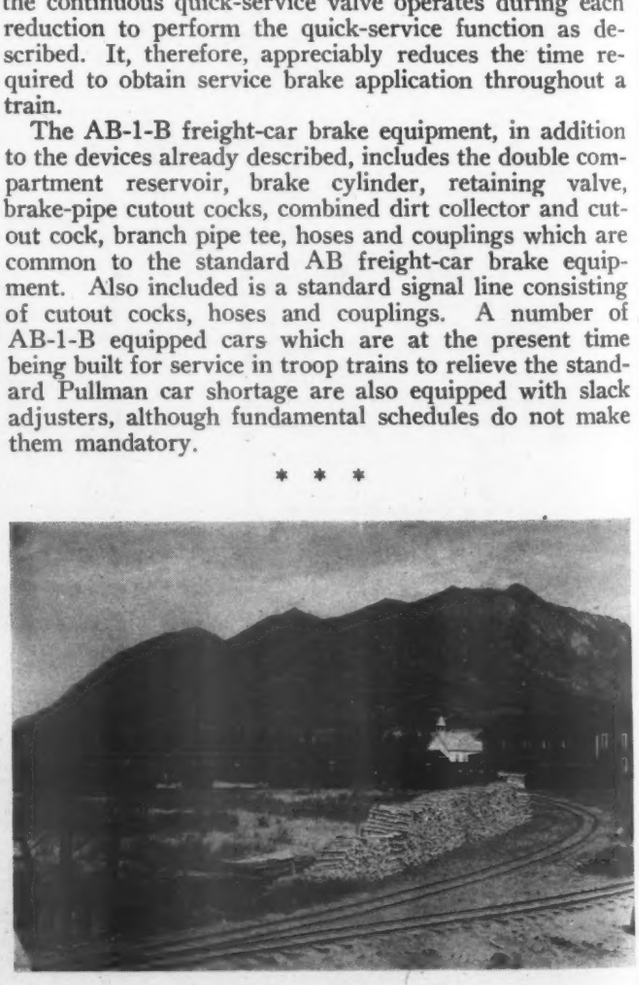


On the White Pass & Yukon

Coal Sizes in Relation to Fuel Economy

How the specific gravity of impurities from coal is used to control the ash content

S. A. Dickson,
Chairman

In attempting to reach that ideal state of perfection in locomotive fuel distribution, an ideal size for every need would undoubtedly bring the highest efficiency, but non-ideal conditions have a way of injecting themselves into the picture with rather inefficient results. As the negro boy who went fishing and came back with nothing but poison ivy remarked, "it ain't what you'all wants, but what you'all gits that counts."

In approaching the problems of the best size for the best results, we should, divide the procurement of coal into three fields:

1—The carrier which owns its own mines and controls the entire output thereof.

2—The carrier that purchases its coal from a definite source with little, if any, fluctuation in the commodity and where such mines are located on its own line.

3—The carrier that is compelled to purchase its supplies on the open market, off line and from any source where supplies may be available.

The problem of the carrier in category No. 1 is quite simple. Assuming the mines to be equipped with a fair degree of modern equipment, the coarser sizes may be screened out and used for stations in the ordinary stoves and heaters. Egg sizes may be utilized for smaller hand-fired power, small locomotive-type power plants and yard locomotives. The smaller sizes, provided they can be cleaned, especially where mechanical cleaning plants are available, would then make an ideal stoker fuel for the stoker-fired locomotives as well as large power plants.

The problem of the carrier in category No. 2 is decidedly more complicated. In such set-ups the commercial demand on the mines may run as high as 50 or 60 per cent of the output and with its seasonal changes the railroad necessarily becomes the buffer between the mines and the commercial consumption.

It is generally conceded that a locomotive can be equipped with the necessary grates to burn economically and efficiently, let us say, 1¼ in. x 0 screenings, but with a constantly changing picture of available fuel, it is obvious that the locomotive must be drafted and grates provided that will burn all different sizes of coal under almost any conditions.

Coaling stations could, of course, be equipped with crushers to reduce all coal to say 2-in. maximum size, but it is doubtful whether there would be any economy in such procedure unless all the locomotives served by such a shed were of a modern type with comparatively large fireboxes. Certainly, it would not be economical to crush egg or lump coal to screening size and then utilize such coal on a heavy Mikado locomotive with 26-in. or 27-in. cylinders and a firebox of probably 50 or less sq. ft. of grate surface. In this connection it might be well to consider the size of the fuel in direct relationship with its characteristics.

Screenings of a rather high B. t. u. content, with a comparatively low ash and sulphur content with a high ash fusion could undoubtedly be used in almost any kind of a stoker—or even hand-fired locomotive, provided the coal could be raked. But should we attempt to place screenings of a B. t. u. content of say 10,000 with an ash fusion of 1800 deg. to 1900 deg. on the same type of locomotive, conditions would become intolerable due to the heavy clinker formations and consequent delays.

The texture of the coal which governs the chemical break-down in the firebox, as well as the breakage in transit and in handling, must be given consideration when the best size for the highest efficiency is considered. A good test tube analysis is not always a good criterion of what will take place in the firebox. Some coal that might analyze rather high in fixed carbon and volatile matter will fail as a good locomotive fuel due to its rapid chemical break-down, in that most of the volatile gases escape unconsumed because of incomplete combustion due probably to the locomotive being drafted for a different kind of coal.

Under the above mentioned conditions it appears that the greatest efficiency can be obtained by making a study of all the fuels offered and taken for consumption and distributing this fuel to the various districts to the best advantage. Such a plan requires constantly changing distribution as it obviously is not possible or even contemplated to change the locomotive characteristics for every change of fuel. This makes it extremely important that type and size of fuel offered be under continuous surveillance.

With the rapid advance of stoker equipped locomotives superseding the hand fire power, the problem of obtaining coal in smaller dimensions becomes more and more acute and present conditions do not help maintain the best possible distribution. Shortage of desirable fuel and sizes coupled to car shortages and fuel storage programs, all make it extremely necessary to make every move in distribution count to the N'th degree.

Coal Washing

Considerable misconception still exists among railway operating and purchasing men as to the meaning of the term "Mechanically cleaned coal." Many visualize mechanical cleaning, which consists chiefly of pneumatic and wet washing processes, as surface rinsing with water applied through sprays when this is definitely not the case.

The washing process is based on a relationship existing between the percentage of impurities in any piece of coal and its specific gravity. The exact relationship existing between the specific gravity and the impurity content of the various fractions of any sized coal is

determined through a washability study of the sized coal involved. In such a study, use is made of several vats containing zinc chloride solutions ranging from 1.60 specific gravity through 1.55, 1.50, 1.45, to 1.40. In selecting cases the gravity range may be broadened or the separation bands reduced to 0.25 specific gravity.

A representative sample of the coal under investigation is first passed through the 1.60 specific gravity solution vat where the heavier impurities such as pyrites and rock will sink. The portion of the sample floating in the 1.60 specific gravity solution is then transferred to the 1.55 specific gravity solution vat where additional impurities and middlings (heavy impurities adhering to coal) will sink. This operation is continued through the various graded specific gravity solution vats until the entire sample has been broken down into the fractions that will sink or float at the different specific gravities used in the study.

After this float and sink study has been completed, the various fractions are reduced, weighed and analyzed. From the resultant data, the loss, the recovery, and the finished product ash content at any specific gravity or point of separation can easily be calculated.

The accompanying table gives the results obtained in the breakdown of a mid-western raw coal that was a poor locomotive fuel when used in its raw state. This data only covers the screened 4 in. x 0 size which is used for locomotive steam generating purposes after having been mechanically cleaned.

During the washing process it is customary to remove all substance smaller than 28 mesh (approximately one-half millimeter) at this mechanical cleaning plant. The finished coal product is 4-in. x 28 mesh. At other mining properties all of the 1¼-in. x 0 screenings are removed making a 4-in. x 1¼-in. sized product.

Effect on Ash Content of Removing High-Gravity Impurities from Coal

	Coal, after eliminating 28-mesh fines (20.55 per cent ash) = 4-in. by 28-mesh, 12.93 per cent ash Per cent				Coal, after eliminating 1¼-in. by 0 screenings (14.8 per cent ash) = 4-in. by 1¼-in., 12.33 per cent ash Per cent			
Separated at	Sink	Ash	Float	Ash	Sink	Ash	Float	Ash
1.60 spec. gr.	4.82	57.95	95.15	10.64	2.75	52.94	97.25	11.08
1.55 spec. gr.	5.84	53.30	94.16	10.43	3.87	46.19	96.13	10.87
1.50 spec. gr.	6.79	49.45	93.21	10.27	4.22	44.51	95.78	10.81
1.45 spec. gr.	8.31	44.69	91.69	10.05	6.16	38.10	93.84	10.54
1.40 spec. gr.	11.17	35.18	88.83	9.76	8.76	32.41	91.24	10.30

Base material: raw 4 in. x 0 coal, 13.68 per cent ash.

It will be noted the ash content of the raw coal 4 in. x 0 (13.68 per cent) is drastically reduced by removing the 28 mesh x 0 in. size of the 1¼ in. x 0 screenings. After this improvement in quality the ash content is further reduced as the specific gravity point descends on the specific gravity scale until at 1.40 specific gravity, the ash content of the 4 in. x 28 mesh floatings is only 9.76 per cent and the 4 x 1¼ in. floatings is only 10.30 per cent.

The variation in ash in the two finished sizes is due to more free impurities that can be removed from the smaller sizes of coal.

It is apparent from the table that a product ranging in ash content from 13.68 per cent to 9.76 per cent can be produced at will by selecting the proper size and the appropriate specific gravity control or separation point. The ultimate point of ash reduction depends upon the inherent ash content of the coal and the specific gravity at which separation ceases to be practical from an economic standpoint. This is the significant factor in mechanical coal cleaning operations: a uniform low-ash product.

Assuming that the coal covered by the table is mechanically cleaned to a 1.45 specific gravity adjustment control. Each piece of substance entering the cleaner is automatically checked against this specific gravity. All substance having a specific gravity heavier than 1.45 will sink, while those of 1.45 specific gravity or lighter will float.

The sinkings are removed, crushed, and rewashed for screenings. The floatings are passed out of the cleaner and, if it is of the wet washing type, will be rinsed with clean water, dewatered on a special screen, and loaded in railway cars for shipment.

At large mining establishments samplers and chemists continually check the quality and uniformity of their product by frequently analyzing samples throughout each day's run. Railway inspectors should watch closely the work of these men and in addition have samples taken and analyzed under their own direct supervision.

While under existing conditions the cost of mechanically cleaned and raw locomotive coal is the same, the results obtained are not.

It can be seen from the data given that mechanically cleaned coal gives the mine operator a positive control over the ash content of his product and assures the consumer a uniform quality low ash coal. To the consumer low ash means increased B. t. u.'s per pound. Railways using raw coal in fields where mechanically cleaned coal is available should carefully investigate the improved locomotive performance and reduced fuel bills that result from the adoption of mechanically cleaned coal.

Owing to the changed conditions brought on by the war the fuel picture for our railroads have also changed. Therefore we must adjust ourselves to meet these conditions before they arrive whenever possible, through foresight and planned schedule. To show one of the many changes that have occurred on our American railroads we quote the fuel picture change of one railroad.

Last year at this time about 66 to 70 per cent of the total coal used was slack coal 1⅝ in. x 0, 1½ in. x 0 and 1¼ in. x 0, depending on the territory from which it was received. This year on account of the emergency the mines will not sell the slack in the same proportions as they did a year ago, and the percentage to the total now used is 35 per cent. Despite this they are using a greater amount of the larger coal, costing more money. For example, in April their fuel cost increased $90,749.00, due to the following:

1—Increase in price	$41,000.00
2—Increase in consumption	11,187.00
3—Due to use of higher per cent larger sized coal	38,562.00
4—Loss of bony	550.00
Total	$90,749.00

In April, 1942, 66 per cent of the total coal used was slack, in 1943, 34 per cent. Naturally, as they purchased a larger size, according to the testimony that they received at their various meetings, they would use less of it than of the slack coal. But, unfortunately, this was not the case.

Of course delays to trains at terminals and enroute, which is reflected in a lower average speed this year was responsible for some of this loss. New men, also, were a contributing factor. How much value should be placed on each of these two items as cause for increased coal, consumption is, of course, hard to calculate.

The report was signed by S. A. Dickson (chairman), supervisor fuel economy, Alton; M. B. Adamson, fuel inspector, C. R. I. & P.; P. E. Buettell, chief fuel supervisor, C. M. St. P. & P.; W. J. Tapp, superintendent fuel conservation, D. & R. G. W.; and S. R. Tilbury, fuel supervisor, A. T. & S. F.

Master Boiler Makers Again "Meet" in Print

Reports on staybolts and flues are presented in this issue—Suggestions for improvements in locomotive firebox design

Myron C. France, President

A. F. Stiglmeier, Secretary-Treasurer

For the second successive year the Master Boiler Makers' Association has been forced, because of the war-time pressure, to forego holding a regular convention. They have chosen, however, to continue the work of their committees and to publish their "proceedings." In 1942, this plan worked out successfully as a substitute measure and the papers submitted by the committees received favorable attention from the entire membership.

Five subjects were chosen for investigation and the preparation of reports in 1943. Of these, only two have been completed to the point where they can be published in this issue. Others will be published in later issues of the *Railway Mechanical Engineer*. All will be available later in the bound volume of the Association's proceedings. In addition to the work of individual committee members the reports are based on summaries of the replies received from the chief mechanical officers of the Class I railroads of the United States and Canada to questionnaires sent out by the Association with the approval of the Mechanical Division of the A. A. R.

Topics No. 1 and No. 4 are covered in this issue: Topic No. 1 is on application of staybolts and service obtained from various types and materials; Topic No. 4 is on the subject of application, maintenance and blowing of flues and tubes. Two papers on each are presented here, one of which is the main report of the committee and the other a contribution of one of its members. The subject of Topic 2 is autogenous welding and cutting in the boiler department; Topic 3 deals with blowing down, washing and filling boilers, and Topic 5 with cinder cutting of flues and tubes, its causes and prevention. The responses received to the questionnaires represented a high percentage of those sent out.

The officers who served during 1943 will continue in office for the year 1944. They are: President, Myron C. France, general boiler foreman, C. St. P., M. & O., St. Paul, Minn.; vice-president, Frank A. Longo, general boiler inspection, So. Pac., Red Wood City, Calif.; secretary-treasurer, A. F. Stiglmeier, general supervisor boilers and welding, N. Y. C., New York. Members of the Executive Board will also continue to serve. There has been one change on the Advisory Board, E. L. Grimm, general mechanical superintendent, Northern Pacific, St. Paul, Minn., having replaced D. S. Ellis, who is now vice-president in charge of manufacture of the Lima Locomotive Works, Inc.

Staybolt Practice and Performance

Progress continues in study of methods and materials—Higher boiler pressures present problems—Boiler design and staybolt spacing important

[The report contained a summary of the answers received from fifty railroads to a set of 36 questions concerning staybolt practice and staybolt performance. The essential information is contained in the committee's discussion of the questionnaire.—Editor.]

Analyzing the questionnaire we find that iron staybolts are still the old stand-by, although there is something taking place in our high-pressure fireboxes that is hard to overcome with iron. When iron staybolts are being driven they leave a picture as shown in Fig. 1.

Questions on service life indicate, at present, that there is no trouble experienced with iron staybolts in regard to breakage or leakage. The reason for this improvement may involve all of the questions asked or it may be only one or two. We are unable to state which one has been the contributing factor. From our own experience, on certain classes of locomotives, and considering the division or territory on which they are operating, we are still undetermined as to the cause of leaky staybolts. We have not found a method, as yet, that will cure it. Some improvements have been made and several new methods have been tried which will be mentioned. General boiler shop practices when applying staybolts, including all operations to a finished staybolt, indicate that we are all making a real effort to have staybolts applied by the best method possible. We believe that there is still room for improvement. On our visits to engine terminals we find that complaints on fit and other details are very much in evidence. Shop forces are held to be at fault. Methods of tightening leaky staybolts are numerous and each one gives very good results. During all the years this Association has had this topic in one form or another, the discussion has been one of the best, but the solution to the problem has never been found. However, according to answers received to the questionnaire, we have no more trouble with staybolts, no breakage and no leakage. The locomotives involved are both freight and passenger. The Master Boiler Makers' have been favorably impressed with chemically treated boiler water and the consensus of opinion is that with a well regulated water treatment boiler and firebox conditions have improved.

It is also the consensus of opinion that if you treat boiler water, a manual or continuous blow-down must be used to get the benefit from treated water. Opinions as to the cause of leaky staybolts are varied although we are of the opinion that seven causes are contributing factors.

Seven Causes of Staybolts Leaking

Mechanically we are partly to blame because staybolts have never been taken seriously because of the easy manner in which they can be made tight. Today, the staybolt is a big factor and proper application must be taken seriously. Overheating is a factor very much in evidence on every locomotive which is stoker fired and, with the great demand for speed and tonnage, it cannot be overcome when extra efforts are needed for steam.

Every locomotive equipped with a feedwater heater will be more or less in trouble, although the feedwater heater is a device for saving water and steam by the use of a condensate pipe into the tender tank. Filters, skimmers and other devices have been tried with very little success for removing the oil from the water returned to the tank through the condensate pipe. Mulsified oil then finds its way back to the boiler. The oil is one of the greatest factors to be overcome.

Some roads are fortunate in that they pick up water on the right-of-way. This will overflow the skimmer or filter when the tank is filled. Others that depend on terminal forces and way-side filling stations are not so fortunate. The tank is never filled to overflowing and the skimmer or filter does not remove the oil. It has been proved by many railroads that releasing the condensate to the atmosphere saves staybolts and side sheets. This may be a fact but there are still some boilers running with heaters operating and condensate water returned to the tanks that also have tight staybolts.

Therefore, the subject of oil is still to be discussed although there is no question that, if oil was eliminated entirely, boiler and firebox parts would be free from leaks and cracks.

We all know what scale will do to our staybolts and side sheets. We believe that a proper and well balanced water treatment or, better still, the use of nickel-clad firebox steel which will remain sufficiently free from scale, gives a cooling effect to the sheets because the water remains in contact with the sheet. Some installations of nickel-clad steel have given increased service life.

Every one of us would like to have the smallest bolt possible because of many factors which will help towards staybolt service life. Opinion seems to favor a staybolt not any larger than 1⅛ in. at fire side. Anything larger than that may increase leakage.

The committee believes that the spacing of staybolts in our high-pressure boilers must be changed. The distortion, or corrugation as you may call it, will pull the head of the staybolts. This is due to strain on the area supported. When this distortion takes place, the staybolt fit in the sheet has been destroyed, as shown in Fig. 2, and hammering or caulking will not make it tight.

If spacing of staybolts is changed there will be no need of a sheet heavier than ⅜ in. in any high-pressure boiler.

Engine-Terminal Procedure

We would recommend that the Master Boiler Makers' Association go on record for the approval of the following procedures which must be adhered to:

When Crew Leaves the Engine—The engine crew will have full fire over the entire grate area, a full head of steam, and at least three gauges of water in the boiler.

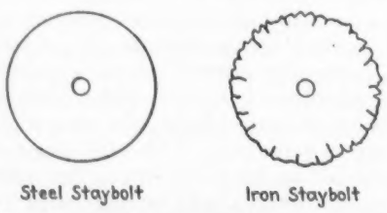


Fig. 1—General appearance of steel and iron staybolts after driving

At Ash Pit—Before starting to clean the fire, check for full head of steam and at least three gauges of water, then open ash pan slides and clean the fire. Use the blower just enough to clear the firebox. After the fire is cleaned, build a fairly good fire over the entire grate area, and bank the edges along the sheets to prevent air from entering the firebox. Fire should be maintained in this condition until the engine is ready for road service when the fire tender should level the fire. If, for any reason, it is found necessary to remove the fire, the following precautions should be taken. Ashpan slides and the fire door should be closed. In cold weather the cab curtains should be drawn. The engine should be moved into the house as quickly as possible.

Blowing Down—Reduce the pressure in the boiler about 25 lb., allowing approximately 15 min. for the temperature to equalize. Repeat this process until the pressure is reduced to about 50 lb. After 30 min. blow the remaining steam pressure and drain the water from the boiler. If the boiler is to be washed out, its temperature should be nearly the same as temperature of the water used to wash the boiler. If it is not the boiler should be allowed to cool until the two are at the same temperature.

Filling—After the boiler work is completed the boiler should be filled with water of the same temperature as the boiler plates and a bed of coal about 3 in. deep placed over the grate area.

Firing Up—Fires shall be raised as follows: 1 hr., 50 lb.; 2 hr., 150 lb.; and 2 hr. 30 min., full pressure. The fire tender should maintain the fire as set up in the procedure until the engine is called for.

Choosing and Applying Staybolts

Fifty Santa Fe locomotives came to one road with a full installation of flexible staybolts and for a period of 12 years the flexible staybolts in the lower portion of

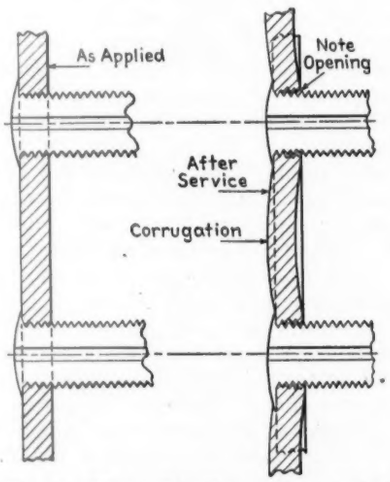


Fig. 2—When distortion occurs staybolt fit in the sheet is destroyed

the firebox required frequent renewals and new side sheets were often applied. Since an outer wrapper sheet was removed and drilled for rigid hollow staybolts service life of the staybolts has been indefinite. It became necessary to remove these sheets after eight years when cracks developed on the water side of the firebox. When holes in the outer wrapper sheet become large, the staybolt shown in Fig. 3 may be used. This method will gain favor because of its simplicity. The staybolt may be of any size, depending on the road's condemning limit. When a staybolt of this type is to be used it should be chased down to thread size and be at least 1 in. longer than the water space in the boiler. Thread the large end, then the small end, allowing the small threading die to come in contact with the large end of the staybolt. This gives a tapered section between the two thread sizes.

The following procedure gives good results in tapping out the boiler for this type of a staybolt. Use any good tap of the right size and break off the reaming part leaving just enough on the remaining piece to give a full size thread in the hole without interfering with the firebox sheet. Weld a pilot on the end of the tap for guidance. Tap the firebox side first with the small tap. Run the large tap through the wrapper sheet far enough to give a full thread. Apply the staybolt, making sure that the small end of the staybolt will enter the firebox sheet first. If all of the staybolts are of the same dimension at the large threaded end there will be sufficient thread on the outside. Cut the staybolts off at both ends. The use of a hollow rigid staybolt will eliminate the necessity of drilling a telltale hole. Application of molybdenum iron staybolts did not show any improvement over the ordinary iron staybolt in regard to heat

Load on Staybolts of Various Sizes at Different Pitches 7,500 Lb. I. C. C. Calculated for 265 Lb. Boiler Pressure—Telltale Hole Used

Bolt size in.	Diameter at root, in.	Area at root, sq. in.	Pitch on sheet, in.	Boiler pressure, lb.	Load on bolt, per sq. in.
7/8	.7668	.4617	3.5 x 3.5	265	7476
7/8	.7668	.4617	3.75 x 3.75	265	8582*
7/8	.7668	.4617	4 x 4	265	9797*
10/10	.8293	.5401	3.5 x 3.5	265	6333
10/10	.8293	.5401	3.75 x 3.75	265	7260
10/10	.8293	.5401	4 x 4	265	8271*
1	.8918	.6246	3.5 x 3.5	265	5436
1	.8918	.6246	3.75 x 3.75	265	6242
1	.8918	.6246	4 x 4	265	7123
1 1/10	.8918	.6246	3.5 x 3.5	265	4720
1 1/10	.8918	.6246	3.75 x 3.75	265	5419
1 1/10	.8918	.6246	4 x 4	265	6165
1 1/8	1.0168	.812	3.5 x 3.5	265	4137
1 1/8	1.0168	.812	3.75 x 3.75	265	4750
1 1/8	1.0168	.812	4 x 4	265	5400

*Not to be used.

in high-pressure boilers although we have been of the opinion that a higher heat-resisting material would improve the condition. The use of Monel staybolts indicated that there are some shop practices which, in all cases, are detrimental to any material whether iron or steel.

Three locomotives of the same type and class, operating in pool service over the same territory, have given varying performances. Two of them failed because of staybolt leakage and cracked sheets within a short time; the remaining locomotive is still in service and the staybolts and sheets are in excellent condition with a very good mileage. All the staybolts were purchased threaded within tolerances allowed. All the taps were within tolerances allowed, but being of a small size, 7/8 in., and not a stock size, only six taps were purchased. On the boiler which had the first application, using the new

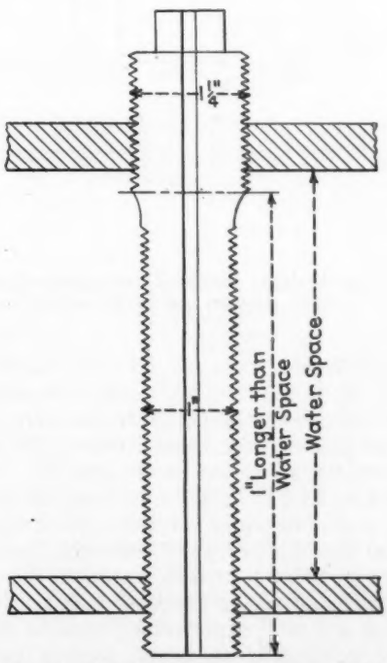


Fig. 3—Staybolt to be used when holes in outer wrapper sheet become enlarged

taps, all the staybolts were applied with a tight fit. Close supervision was given to the application, and this boiler still remains in service and has given no trouble. After all the holes had been tapped on the remaining two boilers, using the same taps, it was found that the purchased staybolts were a little too tight and they had to be recut by the railroad. These applications were not

given any special supervision although regular shop practices were followed. The results were as given.

Electric and Diesel-electric locomotives have passed through the experimental stage and may now be considered as permanent additions to the railroads. With the cooperation of boiler designers, builders and the master boiler makers, we should be able to obtain longer service life from staybolts. The only substantial claims made against the value of the steam locomotive are availability and the high cost of maintenance. Staybolts in one form or another are one of the big problems. Let us give this serious thought, not as individuals but as a craft, in order to overcome this problem.

Welding Staybolts

One road was using iron staybolts and the heads of these bolts would fray, as shown in Fig. 1, while being hammered up. It did not appear that a good seal weld could be made. A test application was made in April, 1943, on a locomotive boiler operating in a territory on which trouble was being experienced in keeping staybolts tight. Leakage sometimes started within three months and sheets had to be renewed within twelve months. The test was made on standard railroad deoxi-

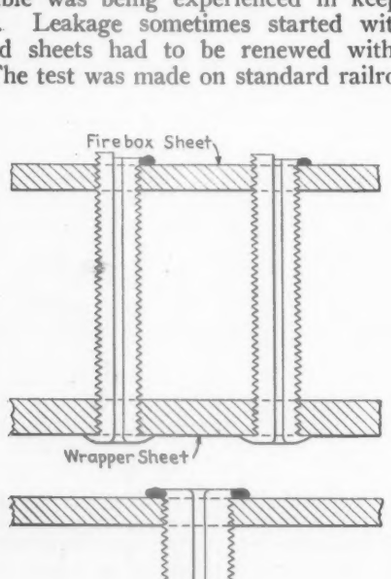


Fig. 4—Edges should not be rolled down when staybolts are to be welded

dized firebox steel with 1-in. dia. iron staybolts on one side of the firebox. A nickel-clad deoxidized firebox steel plate with 7/8-in. Monel steel staybolts was applied to the other side. After being driven, all the staybolts were seal welded as shown on the sketch. The locomotive has made 32,200 miles since application, and both sheets and staybolts are in excellent condition. We wish to submit to the Master Boiler Makers' Association, and if necessary to carry to a conclusion, to the Association of American Railroads, a proposal that six leading railroads, which are now experiencing trouble with staybolt leakage, be permitted, on a new firebox or side sheet renewal to apply hollow rigid or hollow flexible staybolt (hollow rigid preferred) seal welded to the sheet nine rows high from the mud ring.

After the holes are drilled, the surface of the sheets are to be cleaned around the staybolt holes, using the best method available. Sandblasting or grinding are preferable. A soluble oil should be used in tapping the holes. Staybolts should be applied in the usual manner. The staybolts should project three threads out of the sheet for heading over. The staybolts in the outside sheet should be driven first and the staybolts on the inside sheet driven with a flat die. Edges should not be rolled down. When the sheet is clean seal weld the staybolt heads to the sheet with a small bead in one pass if possible, using the best covered electrode available.

Once the staybolts have been seal welded, no further welding is to be applied at any time. If the staybolts develop leaks they should be renewed, cleaned and welded. Reports should be furnished to the Association annually, or more often if necessary.

Well-Formed Staybolts and Accurate Sheet Layout Essential

[In addition to the main report of the committee and the paper by Mr. Huston a short paper dealing with the manufacture of staybolts and the proper layout of firebox sheets as factors in securing good staybolt performance was prepared by Leonard C. Ruber, superintendent locomotive department, Baldwin Locomotive Works, who is a member of the committee. The following is taken from Mr. Ruber's paper.—EDITOR.]

In the fabricating of the staybolts the material used should be sufficiently large in diameter to permit a full thread when the bolts are completed. In threading of staybolts it is important to have machines which preferably have center lead screws, so the pitch of the threads of bolts when completed will be cut to a tolerance of .0015 plus or minus per 1 in. Where possible in order to check the bolts properly for form of threads and pitch of threads a Comparator type of machine should be used; this will always prove valuable in getting first-class threading operation. Threaded bolts should be checked periodically as an assurance against possible changes in the position of chasers in the threading machines, and possible lost motion in wearable parts of the threading machine. In addition to the method of checking with a comparator the operator should be provided with simple gauges so that he can make continual check on threaded bolts.

In all cases a master gauge should be provided to check the gauges used in checking the staybolts.

It is advisable to use hardened-steel ground chasers for the threading operation which give additional assurance of good threads.

In threading the crown stays and all other stays where the ends are upset to larger diameter it is most important that all forgings are made straight and that the upset ends of the bolts are parallel with the axis of the bolts.

After securing a first-class job of fabricating staybolts it is most important that every possible provision be made and every care be taken to have all staybolts applied to boilers so the bolts will give to the purchaser a long life of service.

In applying the staybolts to boilers it is most important the plates be laid out carefully so the line-up will be just as it was intended when the boiler was designed. In order to secure this condition a great amount of attention must be given to the drilling of holes for staybolts and sizes of drilled holes must be sufficiently small to allow the holes to be reamed to the proper diameter for tapping, thus insuring a first-class fit of the staybolts in the holes.

It has always been considered a very good job of staybolting if when bolts are applied they can be turned without much force, but there must not be any possibility for anyone to shake the bolt in the hole. In many cases some men are disposed to consider the bolt loose in hole if it is possible to move the bolt with a small amount of exertion, but the laws of mechanics teach us otherwise, and therefore we have always considered a

ybolt application first-class if applied as outlined above. In applying the flexible staybolt to boiler it is considered by most boilermakers, and rightly so, the best ethod of application is to screw the bolt into the sheets til bolt is properly seated in sleeves. Applying bolts this manner it is a generally accepted fact greater surance is given that each hole is carrying the roper load.

In hammering over the ends of bolts most boilermakers eel if the bolts are properly applied and not loose in ole it is important that a hammer which does not give oo heavy a blow be used. The hammer should be only of a capacity sufficient to properly head over the bolts.

The report was signed by Sigurd E. Christopherson (chairman), supervisor boiler inspection and maintenance, N. Y., N. H. & H.; Leonard C. Ruber (vice-chairman), superintendent boiler department, Baldwin Locomotive Works; C. H. Pollock, boiler foreman, American Locomotive Company; C. G. Mullenhour, superintendent of boiler department, Lima Locomotive Works; S. S. McConnell, general boiler foreman, Erie; C. A. Marinan, mechanical inspector, M. St. P. & S. S. M.; E. J. Brennan, general boiler foreman, B. &. M., and F. P. Huston, The International Nickel Company.

A Study of Firebox Materials and Design

Reduced staybolt diameter and closer spacing recommended to lower stresses both in sheets and bolts

By F. P. Huston,
The International Nickel Company, Inc.

THE following classification of firebox failures pertains primarily to side sheets because the conditions that bring about failure are generally aggravated at the side sheets and hence failures are apt to occur at this location earlier than in other locations. However, essentially the same forces are at work in all locations and failures of more or less the same nature may occur in any portion of the firebox.

Cracked Sheets

Cracks which occur on the fire side only and designated as "fire cracks" invariably start at the edge of the staybolt hole and usually extend in a vertical direction. The cracks may, however, extend horizontally rather than vertically and in some cases in all directions to produce a condition designated as "star cracks".

The immediate cause of the cracking of the side sheets may be attributed properly to leaky staybolts. There is no record of an instance of sheets cracked on the fire side in the absence of leaky staybolts. The ultimate cause of the cracking is the combined action of localized bending stresses in the sheet material due to thermal stresses and the corrosive action of the boiler water leakage concentrated by evaporation from the hot metal surface. This condition is often designated as "stress corrosion".

Cracks on the water side only, in appearance, location, and extent, are usually almost identical with the cracks on the fire side. The mechanism which produces the cracks on the water side must be different from that at work on the fire side since there is no apparent opportunity for the concentration of the boiler water by the simple action of evaporation from a hot metal surface. However, there is an opportunity for concentration to occur under a layer of porous scale. Such concentrated alkali in conjunction with the localized bending stresses on the water side may bring about failure through the same type of stress corrosion as that occurring on the fire side.

Cracks on both the fire side and the water side are obviously caused by a combination of both conditions just described.

Figs. 1 and 2 show different surfaces of a specimen taken from the central portion of a side sheet and illustrate fire-side cracking, water-side cracking, and excessive corrugations. The side sheets represented by this specimen required renewal after only 47,594 miles in the period from May, 1942, to March, 1943.

The remedy for the condition where cracks occur on the fire side only is found obviously in maintaining the staybolts free from leakage and for cracks occurring on the water side only in maintaining the water-side surface free from scale either through the use of adequate water treatment, of a material that is not subject to this type of cracking or of a material to which scale will not adhere.

Excessive Staybolt Leakage

This condition is the result of partially stripped threads due usually to faulty design of the staybolted assembly and the related boiler structure aggravated by the damage done to the threaded joint when corrugating of the sheet occurs as a result of overheating. The leakage ultimately leads to the failure of the sheets from corrosion cracking. The cure for excessive leakage in the case of joints improperly designed is a change in design which will provide an assembly better fitted to carry the load imposed upon it. This may involve a change in the staybolt material, particularly the elimination of the use of soft puddled iron bolts in favor of a material of better mechanical and corrosion resisting properties. A steel of higher tensile strength may be required in the firebox sheet to provide adequate strength in the threads. The seal welding of the bolts may be advisable or a better means of fitting the bolts in the sheets may be necessary. Where failure occurs due to overheating it is necessary to provide against the formation of scale on the water side.

Corrugated Sheets

Buckling of the firebox sheets within certain areas is a normal and a necessary action in order that the sheets may absorb the movements set up by thermal expansion and contraction both in the sheets themselves and in the tubes. However, when, due in many cases to improper firing or improper handling during turn arounds and boiler washes, the stresses become so large that permanent deformation takes place and the condition

known as corrugation occurs premature failure results.

Sometimes a newly designed firebox will corrugate and fail after a relatively short period of service due to unforeseen localizations of stress. In most cases the sheets are able to adjust themselves so that service life comparable to that of the older box is obtained after the first repair, though sometimes failures persist due to inherent faults of design.

The most important cause of corrugating is overheating due to water scale which insulates the metal against the cooling action of the water. The metal in this case may reach temperatures of 1,000 and 1,200 deg. F. Fig. 3 shows diagrammatically the increase in fire-side temperature to 1,010 deg. F. due to a scale layer only .050 in. thick while a scale-free surface under otherwise identical conditions results in a safe operating temperature of 560 deg. F.

Thermal stresses of high order imposed upon metal weakened by the high temperature result in severe permanent deformation. Even before the deformation reaches a point where excessive corrugations are observed an indication of its occurrence is given by the leakage of staybolts, especially when the firebox is cooled down for boiler washing.

The effect of corrugation on tightness of staybolts screwed through with ends riveted over may be shown by applying a pressure to a staybolted test assembly sufficiently high to deform the sheet permanently between the staybolts. Fig. 4 shows such a test assembly where seven 1-in. dia. iron staybolts were applied in a 16-in. dia. closed vessel. The staybolts were free from leakage up to and including 1,500 lb. per sq. in., pressure but leaked freely on reducing the pressure to about 200 lb. per sq. in. The stress pattern in the plate around the staybolts shows the stress concentration at the staybolt holes which compresses the metal at the outermost thread. Leakage starts when the compressive forces are relaxed on reducing the pressure.

This apparently explains the cause of copious leakage which occurs in the side sheets of some fireboxes upon cooling down and which are generally referred to as "cold leaks". The same forces at work both in the test pieces and in the boiler relax the compression on the outer thread; in the test assembly the effect is due to the reduction in temperature.

The buckling of the side sheets may be augmented by the thrust transmitted through the combustion chamber and rear tube sheet when the tubes increase in temperature at a faster rate than the barrel of the boiler. An example of this was found in 20 Santa Fe type locomotives on an eastern road that leaked so badly on cooling down that water cascaded onto the floor of the enginehouse. The leaky condition was largely eliminated by a change to rigid type staybolts in the side sheets which in effect stiffened the assembly and reduced the overall deflection by transferring a large portion of the load to the staybolts.

Broken Staybolts

For want of a better expression, "corrosion fatigue" may reasonably be used to explain the cause of broken staybolts, though in the popular conception of the two terms neither corrosion nor fatigue seem to be involved. Except in rare cases the bolt does not appear to have lost an appreciable amount of metal through corrosion at the break. Nor has it been subjected to the millions of stress reversals such as occurs in the case of axles, crank pins, piston rods, and the like which we generally imply to be a requirement for fatigue failures. Corrosion fatigue does not require the loss of any gre amount of metal by corrosion and, if the level of r peated stress is high enough, the number of repetitio to cause failure need not be the large number usuall associated with corrosionless fatigue.

The particular type of corrosive action that brin about the failure of a staybolt is always associated wit unduly high localized bending stresses and whether or n the action takes place coincident with maximum stre or over relatively long periods under low stress or eve at rest as a result of corroded notches acting as stre raisers, the mechanism does not alter the final result Bolts break under the conditions of stress and corrosio found in locomotive boiler fireboxes.

As it does not seem practical to eliminate the cor rosive action of the boiler water, the cure for broke staybolts lies either in the use of a staybolt materi that is not affected by the boiler water or in reducin the bending stresses to a value which ordinary materials are able to withstand under the conditions encountered. The latter course has been applied on this continent, the former abroad.

The universal use of iron and steel staybolts in thi country and Canada which are articulated in the outside sheets by means of a ball-and-socket joint has proved effective, except in a few instances, in preventing the breakage of these staybolts by reducing the bending stresses. The dangerous section of a rigid staybolt is at the thicker outside sheet. As long as the ball-and-socket joint remains free, the bending stress at this location is reduced virtually to zero. And the bending stress at the fire sheet is theoretically reduced to half that of the rigid staybolt by doubling the effective length of the beam now acting as a simple cantilever

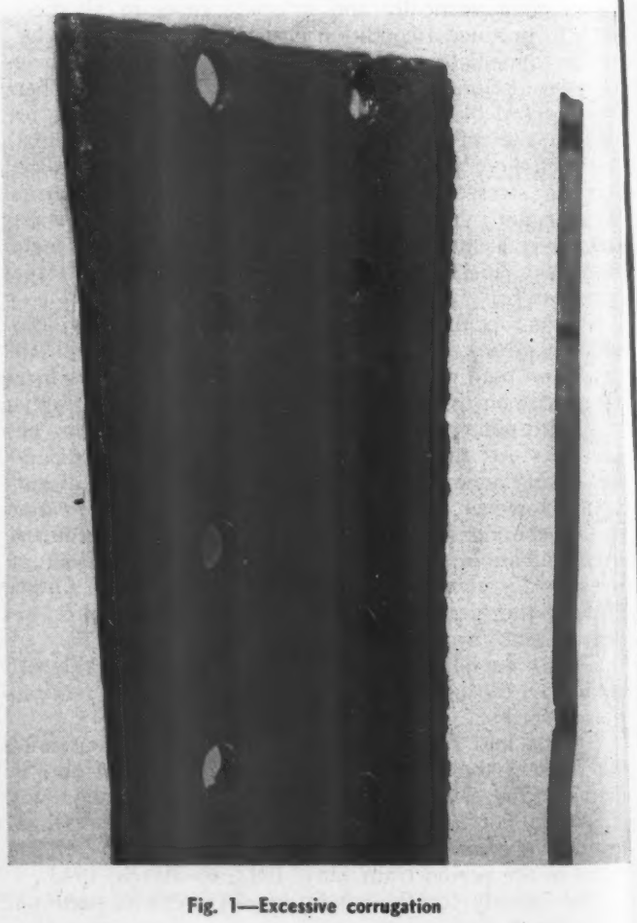


Fig. 1—Excessive corrugation

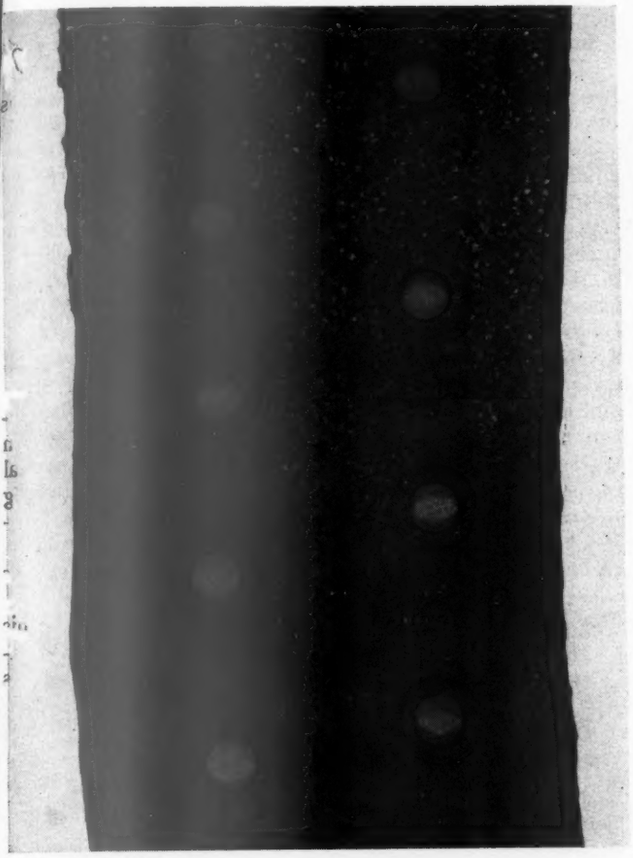


Fig. 2(a)—Fireside cracking

with all the load concentrated at the wrapper-sheet end.

The problem of broken iron and steel staybolts was approached by the European railroads from the angle of a change in material with little or no change in staybolt design. Copper and high-copper alloys, particularly manganese copper were used extensively. Copper-clad steel was introduced but had to be discarded when rupture of the copper sheath was followed by breakage of the steel core.

Monel was first tried in Europe in 1910 for staybolts. Its use progressed to a point where prior to the present war rigid Monel staybolts in breaking zones and complete firebox applications paralleled the use of articulated bolts on this continent.

The Influence of Design

The present locomotive firebox seems to be the outgrowth of all the years of building boilers since Stevenson's Rocket in 1829. The designer is guided principally by certain safety rules together with the experience of his own and other roads.

Safety rules while necessary tend to be restrictive since they are usually written after the design features have been established through usage. Therefore, they fail to anticipate such changes in size and performance demands as have taken place at such a rapid pace within the past quarter century. Experience data based on cut-and-try methods are useful up to a certain point beyond which it becomes necessary to apply more of our technical knowledge of design and materials to solve problems of limitations.

The design features of the staybolted portion of a locomotive boiler are likely to continue to be based largely upon practical considerations and good common sense because of the complication in stress distribution influenced by widely varying operating conditions.

Prof. A. V. de Forest of the Massachusetts Institute of Technology has given us useful tools of "stress-coat" and the electric strain gauge to aid in determining the stress distribution between the sheets and the staybolts in elements of the structure. Stress analyses have been made on two types of staybolted assemblies. The first was made by the stress-coat method on assemblies of two rows, four staybolts per row. These assemblies together with the stress-strain diagrams made in an outside laboratory prior to the work done at M. I. T. are described in the proceedings of the 1941 annual meeting of the Master Boiler Makers' Association, pages 175 to 178.

Though the results obtained in both investigations are substantially in agreement it is deemed advisable in the future to use symmetrical assemblies such as in the second series of tests which are shown in Figs. 5 and 6.

An assembly with the deflection gauge in place and made ready to be placed under the ram of the testing machine is shown in Fig. 7.

In each assembly, the supported sheet representing the wrapper sheet is of plain carbon flange steel $\frac{5}{8}$ in. thick and the overhanging sheet upon which the load is applied, representing the inside or fire sheet, is carbon firebox steel surface ground on both sides to $\frac{7}{16}$-in. thick. The grinding was done to avoid errors in stress measurements due to variations in thickness and flatness. The inside spacing between the sheets, representing the water space, is 5 in.

Assembly No. 1, Fig. 5 (a), duplicates current practice with 1-in. straight rigid iron staybolts screwed through and ends riveted, spaced on 4-in. centers.

Fig. 2(b)—Waterside checking

Assembly No. 2, Fig. 5 (b), is the same except that the pattern is staggered to determine the stiffness and stress relations obtained as if the load on assembly

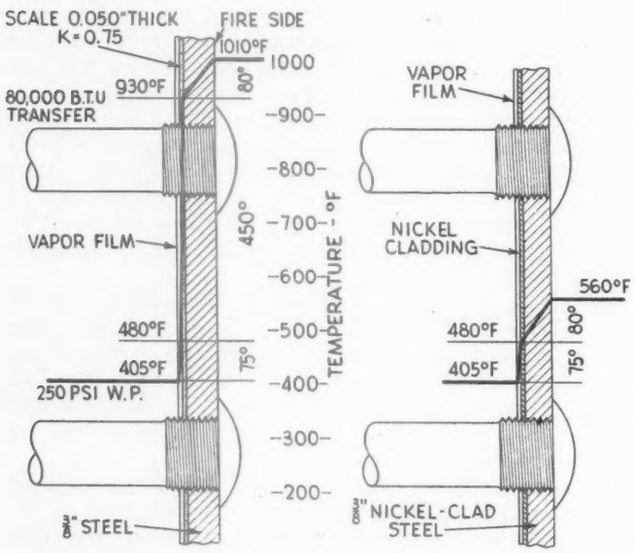


Fig. 3—Effect of scale in raising the temperature of firebox sheets

No. 1 were applied at an angle of 45 deg. to the vertical and horizontal rows of staybolts.

Assembly No. 3, Fig. 5 (c), is stayed with reduced-body Monel staybolts ¾ in. in body, diameter and 1 in. in diameter over the threads, spaced on 3½-in. centers. These were set by means of explosive charges by E. I. duPont de Nemours & Co., Inc., at its Eastern Laboratory, Gibbstown, N. J., under the direction of Dr. W. E. Lawson.

The spacing of each assembly is computed for approximately the same working pressure at equal direct tensile stresses.

A study of the load-deflection curves of assembly No. 2 shown in Fig. 8, which is typical and follows closely those of assemblies No. 1 and No. 3, gives a new conception of the elastic properties of the firebox structure in the narrow water spaces.

Measurements of side-sheet deflections made by the late G. L. Fowler and published in *Railway Age*, December 5, 1919, pages 1088-1094 under the title "Deflections of Staybolts in Locomotive Boilers" show that on standing tests in firing-up from room temperature and cooling down to room temperature a total deflection as high as .050 in. was observed. Under the more severe road conditions it seems logical to assume for design purposes that the deflection may reach a value say 50 per cent higher or .075 in.

The proportional limit of the staybolt material is reached the first time the boiler is brought up to full

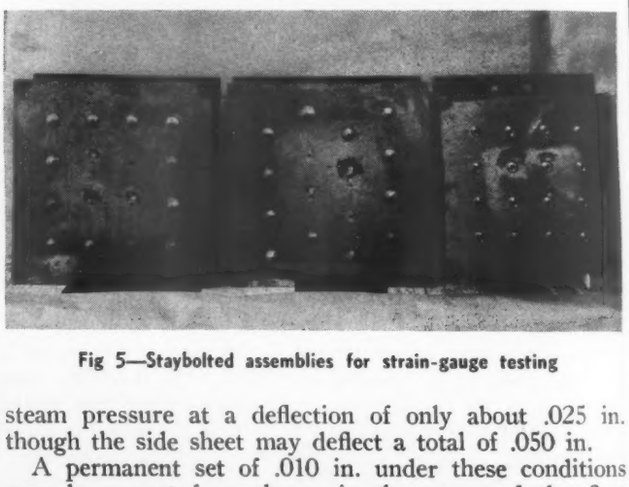


Fig 5—Staybolted assemblies for strain-gauge testing

steam pressure at a deflection of only about .025 in. though the side sheet may deflect a total of .050 in.

A permanent set of .010 in. under these conditions may be expected as shown in the curve of the first test, Fig. 8. Likewise, a second cycle exceeds the new higher proportional limit at about .036 in. deflection to give an additional permanent set of .007 in. and further strengthening of the material through cold work.

It is obvious that, since locomotive fireboxes continue to give service sometimes for long periods of time, our conception of design in respect to the physical properties of staybolt materials, factors of safety of the usual order of ¼ to ⅕ the ultimate tensile strength, endurance limits, and the like must be revised to allow for a certain amount of over-stressing as a normal operating condition. This problem can be approached with confidence in the light of the information we now have available from service records and laboratory studies.

The advantage of smaller diameter staybolts with correspondingly closer spacing as compared with current staybolting practices is clearly shown in Fig. 9, the stress-deflection relations of the three assemblies. The stresses were calculated from measurements made with electric strain gages. These are the stresses in the plate at an average distance of about 3/32 in. from the edge of the hole. The concentrated stress at the edge of the hole where cracking starts may be two or more times these measured stresses. The measured stresses of 19,300 lb. per sq. in. and 21,300 lb. per sq. in. at 0.40-in. deflection for the assemblies stayed with 1-in. iron staybolts may be increased to stresses of the order of 38,000 to 42,000 or higher as concentrated

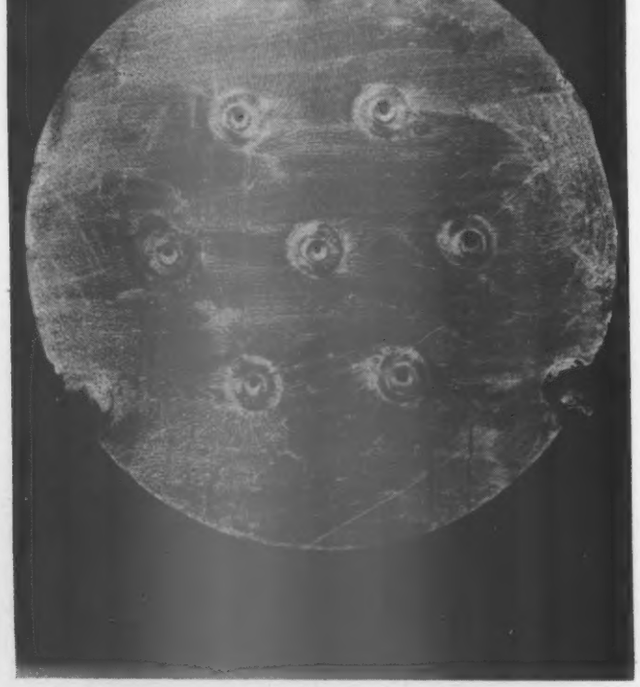


Fig. 4—Assembly for testing the effect of permanent distortion of sheets on staybolt tightness

stresses at the edge of the hole. These are reduced to less than half by the change to the smalled staybolt in assembly No. 3.

The added load on the staybolts and firebox sheets imposed by the thrust of the tubes and combustion chamber may reach values large enough to cause an already overloaded firebox to buckle and fail prematurely. A small part of the increased length is taken up by flexure of the front tube sheet and a larger part by the sagging of the tubes but, when an increase in length of a 20-ft. tube may reach values of ⅛ in. or more depending on the scale and the rate of heat transfer, some means to reduce the thrust such as expansion rings in the combustion chamber should be considered.

With the presence of overheating due to scale, high stresses, and the accelerated corroding action of boiler water concentrated at leaks, cracked sheets will continue until corrective measures are taken.

The Influence of Staybolt Fitting Practice

The efficiency of the staybolt fastening, particularly in the side sheets, in maintaining tightness against leakage is an important factor in the life and maintenance of fireboxes. The load on the staybolt fastening has increased over the past 20 years or so with the increase in the size of the boxes, in firing rates, and thermal strains from shortened periods for turn-around, dumping, washing and firing-up. As a result, the old method of applying bolts by screwing through and riveting over does not provide a joint strong enough to carry the load with a sufficient margin of safety.

Assuming a good fit in the threads only the outside thread or thread and a half at best is made tight by driving. Tightness of screwed joints in a fastening for firebox service required to withstand severe flexing is obtained by a direct compressive force and, to be effective, all of the engaging threads should be compressed.

Consideration must be given to the strengths and the elastic properties of the staybolt and sheet material.

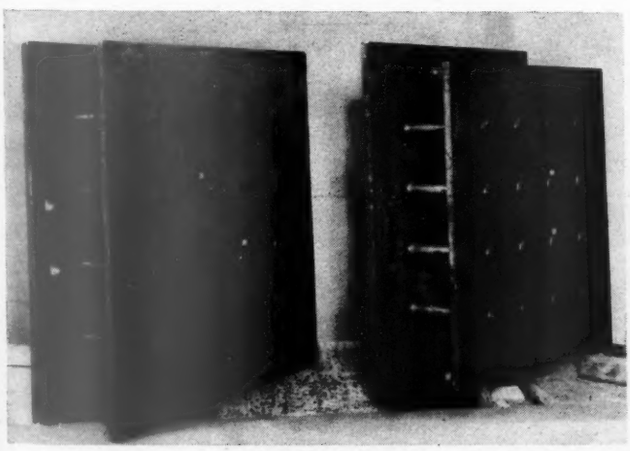


Fig. 6—Another view of the assemblies for strain-gauge testing

The sheet should have a higher elastic strength than the staybolt in order to grip the threads properly. However, good joints can be obtained with sheets of slightly lower properties than the staybolts if all engaging threads are under compression.

A tentative rule might read: "The yield point of the firebox sheet shall not be less than the yield point of the staybolt". An example of bad practice would be the use of staybolts having a yield point of 50,000 lb.

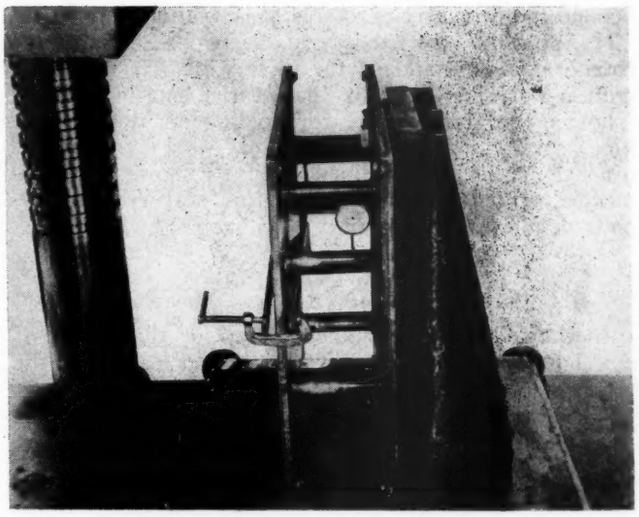


Fig. 7—Staybolted assemblies ready for testing

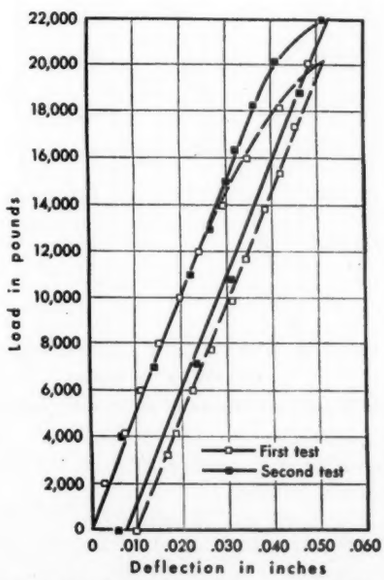


Fig. 8—Load-deflection curve of test assembly No. 2

per sq. in. expanded into a sheet of 30,000 lb. per sq. in. yield point. In this case, the soft plate will expand plastically to a greater degree than the staybolt to give a fit looser after driving than before if the bolt is expanded to a considerable degree. This is the same effect that is obtained in over-rolling tubes.

An effective method is in use abroad for expanding staybolts throughout the thickness of the sheet by drifting enlarged holes in the ends of hollow bolts. This type of stay is reported to provide a permanently leak-tight joint. It is, however, comparatively expensive to manufacture.

To offset the additional costs of enlarging the holes in the ends and machining the bolt from over-size bars experiments are being conducted in this country using explosive charges to expand standard reduced-body staybolts. The same effect in expanding all engaging threads is obtained as with the drifted bolt.

An alternate method for making permanently tight joints which is immediately available subject to the approval of the I. C. C. is through the use of seal welding. The following procedure is suggested: (1) Provide staybolts of such length as to give an extension

beyond the fire sheet of 3/32 to 5/32-in. after hammering, (2) Apply the screwed stay in the regular manner and to the existing standard for thread fits, (3) Hammer with a flat snap straight against the end of the bolt following regular practice for holding on, double gunning, or bucking-up and, (4) Seal weld by approved practice in lieu of heading. Fig. 10 shows a recommended procedure for driving and for seal welding staybolts on the fire side.

Designing New Boilers

In the following recommendations for the design of new boilers a definite move is suggested leading to the use of smaller diameter staybolts on closer centers than those now in current use.

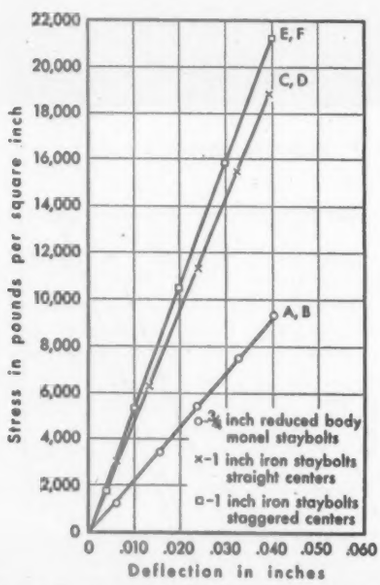


Fig. 9—Stress-deflection relationship of the three test assemblies

1—Limit the diameter of staybolts in all locations where the water space is 10 in. or less to 7/8 in. dia. for both straight rigid and reduced-body stays.

2—Limit the spacing to yield a gross unsupported area not to exceed 14.06 sq. in. which is equivalent to a square 3¾-in. by 3¾-in.

3—Compute the stress in the stay due to boiler pressure to as near a maximum of 7,500 lb. per sq. in. as practicable.

With the above limitations in mind the narrow water space in a boiler operating at 285 lb. per sq. in., for example, would be stayed with 1 13/16-in. by 1 1/16-in. reduced-body stays, drilled with 7/32-in. telltale holes, spaced to a gross unsupported area not to exceed 13.38 sq. in. or very slightly over 3 5/8-in. by 3 5/8-in.

For a boiler pressure of 250 lb. per sq. in. under the limitations suggested above, the narrow water spaces would be stayed with 1 13/16-in. by 1 1/16-in. stays spaced not to exceed 14.06 sq. in or 3¾ in. by 3¾ in. A better construction with longer life expectancy would be obtained with ¾-in. by 1-in. stays spaced not to exceed 12.74 sq. in. or very slightly over 3½ in. by 3½ in.

4—Until such a time as a better and cheaper method is found, seal weld all staybolts on the fire side at the time of application subject to the approval of the I. C. C.

Those fearful that by seal welding the crown stays the force of an explosion due to low water is increased should equip the firebox and combustion chamber with syphons or other types of circulators which have proved safe in limiting the area of dropped crown and hence the rate of steam liberation to below that necessary to cause an explosion.

5—Use Monel reduced-body rigid staybolts in all locations where normally iron or steel stays equipped with a ball and socket joint at the outside would be applied.

6—Use nickel-clad steel side sheets and other firebox sheets if overheating due to water scale is experienced with similar classes of power operating under like conditions.

7—Side sheets and preferably the entire firebox should be of steel having a tensile range of 70,000 to 82,000 lb. per sq. in. This applies likewise to the steel base of nickel-clad steel.

8—Expansion rings rolled inward should be provided in the combustion chamber.

It is apparent that a need exists for modernizing the locomotive boiler to meet the demands of present-day operating conditions. Firebox failures are seriously hampering the war effort in the loss of locomotive time out of service for repairs, the consumption of materials urgently needed for other purposes, and the use of man-hours of skilled labor that could be applied to better advantage on other work. Improvements now in the interest of the war effort will react favorably in the post-war period, primarily in reducing the operating costs of locomotives, and improve the competitive position of railroads using steam locomotives.

It can be confidently stated that through minor changes in design, and through the use of better materials properly applied, a very considerable economy in firebox maintenance cost can be realized and the desired increase in locomotive time on the road can be obtained.

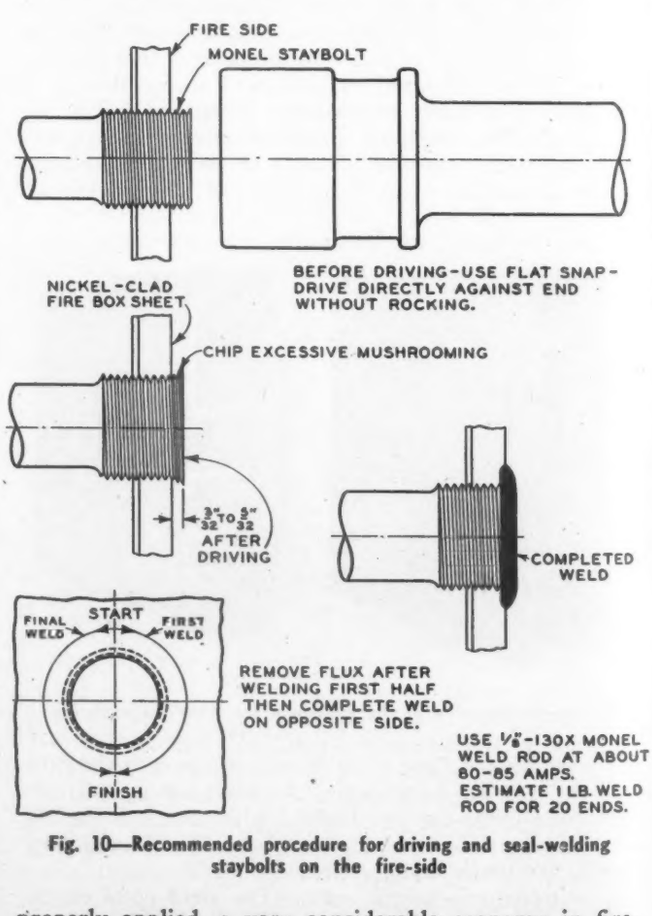

FIRE SIDE
MONEL STAYBOLT
BEFORE DRIVING-USE FLAT SNAP-DRIVE DIRECTLY AGAINST END WITHOUT ROCKING.
NICKEL-CLAD FIRE BOX SHEET
CHIP EXCESSIVE MUSHROOMING
3/32" TO 5/32" AFTER DRIVING
COMPLETED WELD
FINAL WELD
START
FIRST WELD
FINISH
REMOVE FLUX AFTER WELDING FIRST HALF THEN COMPLETE WELD ON OPPOSITE SIDE.
USE 1/8"-130X MONEL WELD ROD AT ABOUT 80-85 AMPS. ESTIMATE 1 LB. WELD ROD FOR 20 ENDS.

Fig. 10—Recommended procedure for driving and seal-welding staybolts on the fire-side

Application, Maintenance and Blowing of Flues and Tubes

Few changes in practice developed during past year—Prevention of necessity for maintenance the goal—Pressure cleaner for flues described

E. H. Gilley,
Chairman

Application of Flues and Tubes

The method of flue and tube application today is practically the same as that used since the advent of the steam boiler. True, tools have changed with the times and more progressive and simplified operations have been devised, but the fundamentals are the same. Flues and tubes are set to length in the back tube sheet, flared, rolled, or prossered and beaded. Flues and tubes may be applied with or without copper ferrules and the seal welding of the beads to the back tube sheet depends upon service requirements and water conditions.

When measuring over tube sheets for the length of flues and tubes it is well to take a sufficient number of measurements to insure getting the average length, allowing tubes to be ½ in. longer than the distance over the sheets and flues 5/8 in. longer. This allows sufficient material for beading at the back tube sheet and flaring at the front tube sheet. Flues and tubes should be cut accurately to length and, before they are placed in the boiler, care should be taken to see that ends are clean and smooth and all scale and burrs removed.

In the preparation of a back tube sheet, when holes become 1/32 in. out of round, they should be reamed with a straight reamer and have a copper ferrule applied. The outside diameter of ferrules should be of the same size as the flue and tube holes, and ferrules should be set into the tube sheet 1/32 in. from the fire side and tightened in the holes by using straight sectional expanders and flaring on the water side.

Set flues and tubes to length in the back tube sheet and flare with a standard flaring tool, prosser with a standard sectional expander using No. 60 riveting hammer. The expander mandrel should be driven into the expander until the flue or tube is tight against the sheet, then slacked off and the expander turned slightly in the flue or tube and driven in again. This should be repeated three times or until flue or tube is properly set and evenly expanded in the sheet. When all flues and tubes have been prossered in the back tube sheet, they should be rolled in the front tube sheet, using a standard roller expander, and such flues and tubes as require it should be beaded in the front tube sheet in accordance with standard practice. The boiler should be tested before flues and tubes are beaded in the back tube sheet to insure their being properly and evenly expanded and that they do not leak. Bead flues and tubes with standard beading tools, taking care to see that nothing enters between the bead and the sheet.

If flue and tube beads are to be seal welded to the tube sheet, the beads and tube sheet should be sandblasted to remove all scale, oil and grease, insuring a clean welding surface, when all flues and tubes are welded, the flues and intermediate tubes should be welded first, and then the tubes, in accordance with the standard welding practice of the railroad.

If tubes are not seal welded, they should be given a light rolling after beading to rectify any lifting of the tubes that might have occurred in the beading operation.

Maintenance of Flues and Tubes

The question will naturally arise as to why maintenance is necessary if a good application of flues and tubes was made in the shop, adequate water treatment with definite road and terminal blowdown schedule maintained, proper terminal handling, both inbound and outbound, given and in the absence of, or with the minimum amount of, cinder cutting. We may assume that the necessity for flue and tube maintenance can be attributed to any one or a combination of the above definite factors, which, if neglected or improperly performed, will result in the unnecessary reworking of the flues and tubes, shorten their life and, perhaps, lead to serious flue or tube failure. We are, therefore, interested in the prevention of flue and tube maintenance rather than in the maintenance itself.

The prevention of flue and tube maintenance is, in most respects, largely a matter of supervision and engineering. The present manpower shortage has seriously affected the railroads in that the younger mechanics and apprentices have been called into the armed services, the helpers have been set up to mechanics, and they have been replaced, in part, by older men and women. The supervisor has been called upon to train and break in these new men and women as well as to maintain increased supervision responsibilities due to heavier repair programs and the placing in service of older locomotives which ordinarily would have been retired, or perhaps scrapped.

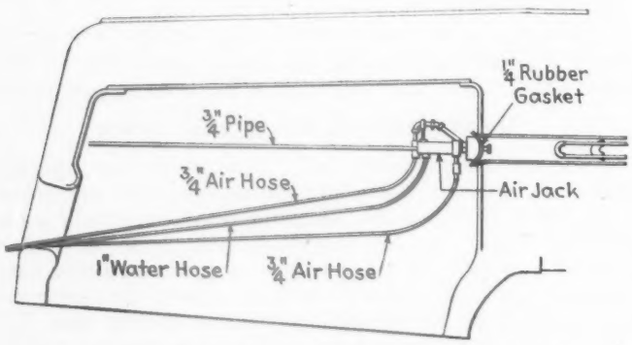
A majority of our railroads have a standard practice covering all or most of the repair and maintenance operations. This is particularly true of flue and tube application and, no doubt, covers all tools used, both as to design and permissible tolerances and methods of performing each operation in the setting, prossering, rolling, beading and testing.

Treating of boiler feedwater is primarily the responsibility of the water service engineer. Road blowing of locomotives to maintain the desired ratio of dissolved solids is a function of the road foreman of engines or traveling engineer, while the schedule of terminal blowdowns is the direct responsibility of the locomotive foreman, boiler foreman or boiler inspector, each of whom should be fully conversant with, and able to analyze the boiler waters to maintain the desired alkalinity ratio with respect to dissolved solids.

Terminal handling of locomotives has a very definite part in flue and tube maintenance. The drop in temperatures when cleaning or dumping fires at the cinder pit, loss of time in handling the locomotive between

the cinder pit and the house, heavy and prolonged use of the blower at the cinder pit or in the house, too rapid blowing down of the boiler at washout periods and quick build up of steam pressure on the dispatch track, are all the responsibility of the supervisor.

Cinder cutting has been the direct cause of most of our flue and tube maintenance and has been responsible for some very serious flue and tube failures in which injury to employees has resulted. Cinder cutting is the result of high draft and the necessary high firing rates to get maximum capacity from the locomotive and is influenced by the resistance of the superheater units and front-end appliances to the free flow of gases. A decrease in cinder cutting can only be brought about by reducing the loss of unburned fuel and decreasing the draft velocity. This is a problem for the engineers. We, however, as master boilermakers, are confronted with the necessity of maintaining rigid inspection of and making costly repairs to the parts affected by the cutting action of the cinders.



A shop-made device for cleaning flues and superheater units

The whole subject of flue and tube maintenance, therefore, is prevention of the necessity. Do your standard practices fully cover present-day requirements and are the employees under your supervision working in strict accordance with such standard practices?

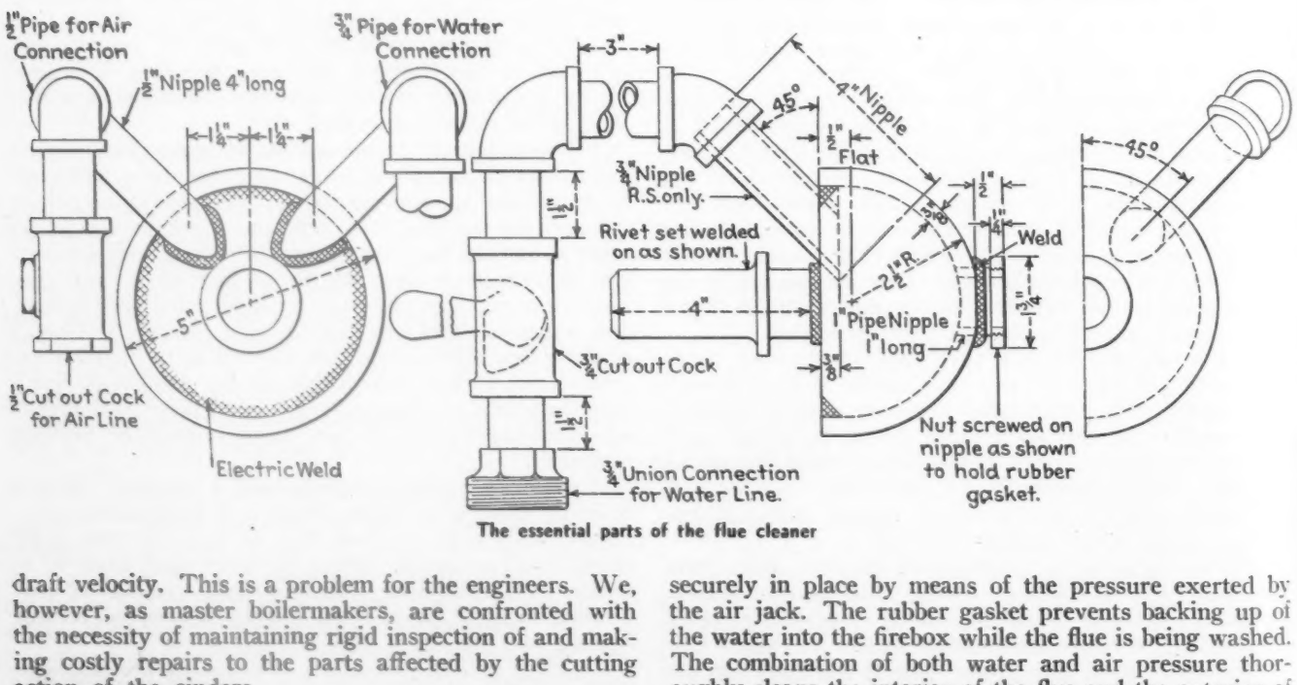
Blowing of Flues and Tubes

Modern high-pressure locomotives are now equipped with automatic soot blowers and, if operated on the road by enginemen in accordance with instructions of one to two minutes' operation each hour while running, drifting or standing; and by the cinder-pit crew when fires are dumped or cleaned, they will maintain flues and tubes open and free of soot and cinders. They will assist materially in preventing slag build-up on superheater unit return bends, honeycombing of tube sheets, flues and tubes, and will eliminate to a great extent the blowing of flues and tubes by the enginehouse forces.

Coal-burning locomotives, not equipped with soot blowers, should have flues and tubes blown and the slag removed from superheater unit return bends each time the fire is dumped. At washout periods individual attention should be given to each flue and tube to insure its being open and free of soot and cinders. Any cinder accumulation in the smokebox at the front tube sheet should be removed.

With the present service demand, and at the high speeds locomotives are now operating, it is not unusual to find from one to ten flues or tubes completely blocked. In some instances the use of an auger is required to open up the flue or tube to permit entering the flue blower pipe which should be used in each flue and tube and should be of sufficient length to extend one foot beyond the end of the flue or tube into the smokebox.

Flues and superheater units may be thoroughly cleaned at washout periods by washing under pressure. A device whereby this may be accomplished is made of a hollow half ball having a ½-in. diameter nozzle in the ball end to which is attached a rubber gasket of the same overall diameter as the half ball. Air and water connections are made to the flat side of the half ball and a mandrel is fastened to it for attaching an air jack. The ball is placed over the firebox end of the flue and is held securely in place by means of the pressure exerted by the air jack. The rubber gasket prevents backing up of the water into the firebox while the flue is being washed. The combination of both water and air pressure thoroughly cleans the interior of the flue and the exterior of the superheater unit, and where this method of washing the flues is used it is possible to go from washout to washout without any additional attention to the flues.



The essential parts of the flue cleaner

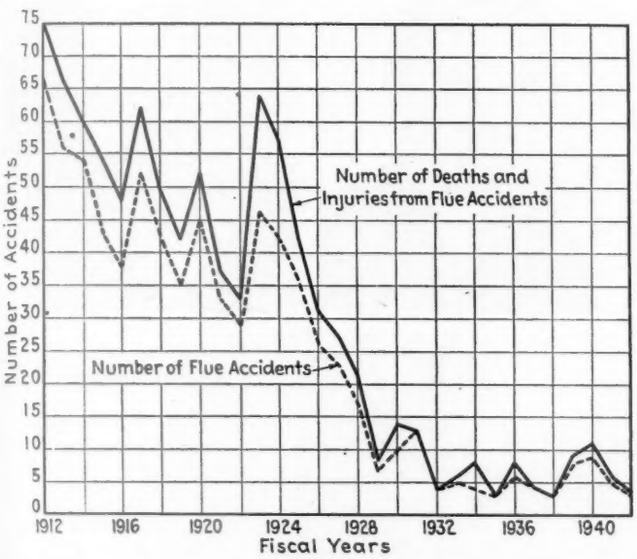
The report was signed by E. H. Gilley (chairman), general boiler foreman, Grand Trunk; I. N. Moseley, general boiler maker, N. & W.; R. A. Culbertson, district boiler inspector, C. & O.; A. P. Lieder, general boiler inspector, Michigan Central; L. D. Prior, regional boiler inspector, B. & O.; William Henry, general boiler inspector, Can. Pac.; H. A. O'Neil, district inspector, Interstate Commerce Commission; E. Crapper, chief boiler inspector, Argentine Railways.

Maintenance of Tubes and Flues for Safety

The situation has improved since 1911—Still opportunity for further reduction in number of preventable accidents

[Accompanying the report of the Committee on Topic No. 4—Application, Maintenance and Blowing of Flues and Tubes is a paper by H. A. O'Neil, district inspector, Interstate Commerce Commission, dealing with the effect of the locomotive inspection law on the number of accidents and casualties caused by failures of tubes and flues. The following is taken from Mr. O'Neil's paper.—EDITOR.]

In the railroad industry for many years, apparently intentionally and deliberately, we condoned the existence and continuance of locomotive practices and methods that were neither economical nor safe. This refers to the days when the poorer engines were invariably sent to outlying points; when workmen, in many cases, through pressure or threats, were forced to perform grossly improper and unsafe repairs. Even employees themselves made repairs or employed practices that were improper and unsafe. It appeared then that the practice of putting engines into service regardless of their mechanical condition provided the wheels would turn and regardless of efficiency, safety or economy was regarded as an indication of real accomplishment by those responsible.



The decline in the number of accidents and injuries resulting from flue accidents since the enactment of the original Locomotive Boiler Inspection Act

Even as late as 1910 very little was known by the railroads concerning the extent of accidents. Unfortunately, the records show that to correct this, to promote and insist upon safety, it became necessary to enact stringent national laws. The Locomotive Inspection Act was first enacted on February 17, 1911. Its object as stated in the preamble was: "An Act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their locomotives with safe and suitable boilers and appurtenances thereto."

During the first year of the law there were 66 flue accidents which, presumably, or at least as far as is known, was an average yearly number. The reduction of flue accidents from the above figure to an average of only four or five per year was effected by the law. Another indication of general improvement is shown by the fact that thirty years ago 5,000 to 25,000 miles per engine failure was common, while today 100,000 to 200,000 miles per engine failure is not uncommon on some railroads.

Before the enactment of the Locomotive Inspection Law it may have been legitimate to plead ignorance as an excuse for responsibility, but it would seem that such pleading should have long since been unacceptable. What, then, can be used to justify the unwisely used authority apparently executed by some one which was responsible for the following accident which occurred in 1940, 29 years after the law went into effect: "Superheater flue broke off near back flue sheet, due to excessive grooving on the water side; flue reported leaking on June 12, 26 and 27, and July 3, and on July 6 before the accident the boiler foreman reported: 'I recommend engine be removed from service account bad flues.' One injured." Was it economical; was it safe, or was it efficient to place that locomotive in service?

The accompanying chart shows in line *A* the number of flue accidents by fiscal years ended June 30 from 1912 to 1942. Line *B* shows the number of deaths and injuries caused by those accidents.

It would appear that for the period of the time the law has been in effect, had the number of flue accidents continued at the average per year for the first ten-year period, there would have been 1,438 accidents. Had they for the full period accumulated at the average per year for the last ten-year period, there would have been only 155 accidents. Assuming that the pre-law yearly average was approximately the same as the first ten-year average, it indicates that there were at least 41 flue accidents each year that could have been prevented by the exercise of proper care.

The committee urgently requests every member to perform all inspections, repairs, etc., so that the requirements of the law will be more than complied with; that there will be a still further reduction in accidents, and that the cause or reasons for such accidents as those listed below, all of which occurred during the past five years, will no longer be allowed to exist until they cause injuries or death:

Fire tube broke off at back tube sheet, thickness of tube reduced to 1/32 in. at point of failure due to excessive use of expander and to corrosion between tube and copper ferrule. One injured.

Flue failed at back tube sheet; flue overworked and reduced to paper thickness. One injured.

Locomotive not steaming properly; combustion chamber filled with cinders up to and including the fourth row of tubes and most of the tubes below the superheater flues stopped up. One flue and one tube leaking and caulking edge of tube-sheet combustion chamber seam leaking. Three of the four bolts missing from the diaphragm plate over the superheater header, allowing plate to swing out of place. "Clean out flues" was reported on August 3, 6, 7, 9, 12, 24 and 26 (after accident). One injured.

Superheater flue failed due to being reduced in thickness by cinder cutting. A similar flue failure occured in this locomotive two days prior to this accident. One injured.

In Spite of Difficulties

C.D.O.A. Continues to Function

Membership is built up—Reports received from practically all committees for publication in the yearbook

THE Car Department Officers' Association was organized to bring together supervisors interested in car-department matters for the advancement of knowledge pertaining to safe and economical operation, and to exchange ideas, discuss problems, promote uniformity, effect economies in car construction, maintenance and operation; also to make constructive recommendations to the Association of American Railroads. A further important function is to work with shippers to improve loading methods so that delays in shipments critically needed in these times may be avoided. The association completed its forty-second year on October 1, 1943, with 1,400 members located throughout the United States, Canada and Mexico and a drive is now being conducted to increase the membership for the period ending October 1, 1944.

The activities of the association have been carried on with difficulty during the last year owing to the pressure on car supervisors to turn out a much greater volume of high-quality car inspection and repair work with reduced forces, loss of experienced car men to military service and frequent delays in getting materials necessary for prompt repairs. Car foremen and supervisors who belong to this association have found it exceedingly difficult to attend committee meetings of any sort or in many cases even to contribute to committee reports by correspondence. It is a tribute largely to the committee chairmen that all of the reports scheduled for this year have been prepared and will be included in the yearbook.

The affairs of the association have been handled during the year by Acting President A. J. Krueger, general superintendent car department, Nickel Plate, in the absence of President Frank E. Cheshire, formerly assistant superintendent car department, Missouri Pacific, and now serving as lieutenant colonel, United States Army, Transportation Corps, commanding at Camp Millard, Bucyrus, Ohio, where railway shop troops are now in training. Vice-presidents of the association, who are holdovers from the last annual meeting, include G. R. Andersen, assistant superintendent car department, C. & N. W., Chicago; D. J. Sheehan, superintendent motive power, C. & E. I., Danville, Ill.; I. M. Peters, secretary and superintendent, Crystal Car Lines, Chicago; P. J. Hogan, supervisor car inspection and maintenance, N. Y., N. H. & H., New Haven, Conn. The present secretary-treasurer is F. H. Stremmel, assistant to the secretary, A. A. R. Mechanical division, Chicago.

A. J. Krueger, President

F. H. Stremmel, Secretary-Treasurer

A complete list of C. D. O. A. committee subjects and personnel was published in the September, 1943, *Railway Mechanical Engineer,* page 441. Some of these reports are included in the following pages and others will be abstracted in subsequent issues.

Report on Repair Methods and Shop Kinks

A review of the essential facilities for a light car-repair plant

The committee has been endeavoring to obtain descriptive matter covering additional shop kinks, similar in character and usefulness to those described in our 1941 report. However, due to the heavy increase of work on our own individual assignments and the inability to travel and make the necessary contacts, this phase of activity had to be set aside for the time being. Therefore, we submit for your consideration, a discussion of the situation with respect to shop equipment and facilities which now exist on many of our railroad light repair tracks and what we consider should be done to alleviate it.

This report pertains to those light repair tracks where only running repairs are made and a maximum of 30 to 35 men are employed.

For the most part, light repair tracks have been established to expedite loaded car movement, to condition freight cars for specific types of loading or to save movement of bad order cars over main tracks in scheduled trains. In some cases, new sources of traffic have created the need.

Many Light Repair Shops "Grew Like Topsy"

Observation indicates that many light repair shops were established without careful planning and consideration as to location and facilities required. At many points a few old box cars were set off on the ground to provide stores and locker facilities; a few tracks were laid down; some tools consisting of a few jacks, wrenches, etc., were put at the disposal of a car foreman, and a new light repair track was born. Little or no thought was given to efficiency, quality of work or production. Such establishments, and there are many, remind us of Topsy—they simply grew. If the car foreman happened to be of the industrious and aggressive type, he eventually built up the shop to a more or less workable arrangement, but the lack of foresight in planning a layout to meet the present and future needs, definitely limited his plans for expansion and improvement.

The need for providing adequate light repair facilities has never been more apparent than it is today. Heavy increases in freight movement together with a serious lack of manpower and the grave possibility of these problems increasing, brings us to the fuller realization of our predicament.

In this discussion, it is not our intention to attempt to set up specifications for a modern light repair shop; rather, we desire to set before you some of the most vital requirements common to all such shops and of which at least one or more are lacking at virtually every point. We are aware of the fact that requirements for track layout, size and kind of building, machine tools, etc., depends on the location, type of cars to be serviced, number of men, and various other circumstances.

R. K. Betts,
Chairman

The Spot System of Repairs Has Many Advantages

As we approach the question of shop track layout, we emphasize that this cannot be a standard set up for all railroads. However, if track room permits and tracks are open to switching at either end, the spot system of repairs has some distinct advantages. To mention a few, the work is concentrated in one locality which lends itself to more efficient supervision; movement of small tools is brought to a minimum; material deliveries are made quicker and with less labor; and permanent trestles, wheel-handling facilities and truck hoists may be installed. Processing the work by specialists on trucks, wood work, air brakes, steel work, etc., is also made possible and the amount and quality of work turned out are improved.

It is unanimously agreed that every light repair shop track should have paved run-ways. Light repairs to freight cars is a 365-day per year operation which, for the most part, is performed out of doors and in all kinds of weather. Dry footing for the workers and a firm roadway for shop vehicles is an absolute necessity. Pulling acetylene cutting and welding outfits, air-brake wagons or carts, rivet-heating forges and similar vehicles through mud, snow or ice is not only a difficult task, it is detrimental to good safety performance.

Careful and deliberate consideration should be given as to the size, location, arrangement and construction of shop buildings. They should be centrally located and of sufficient capacity to house the maximum forces which may be employed. Several recent installations have been made where the office, locker and wash rooms, storeroom, blacksmith shop, mill, air brake room, oil house and paint room are all under one roof. This single unit type of building has some distinct advantages which are well worthy of consideration. Plumbing, lighting and heating facilities may be installed at a minimum cost and subsequent economical maintenance is possible. A central heating plant saves fuel and reduces fire hazards. The building or buildings should be of fireproof construction such as concrete block, asbestos sheathing or brick. Office, locker and wash rooms should be well ventilated and lighted and so designed that a sanitary condition may be maintained at all times.

Importance of a Properly Equipped Blacksmith Shop

The blacksmith shop equipment should include a forge, anvil, face plate, bolt-threading machine, double grinder, drill press and straightening press of suitable capacity for light work. Our blacksmith shops have been virtually indispensable in the reclamation of material during this war emergency.

While the modern freight car is principally of steel construction, many thousands of composite wood and steel cars are still in service and the necessity for wood-working machinery cannot be overlooked. The mill room should contain a band saw, cut-off saw and possibly a small planer. One of the new types of portable power saws should prove a valuable asset.

The installation of air-brake test racks, journal-truing lathe, brake-beam repair devices and similar shop machinery is optional. Many railroads have inaugurated the policy of performing wheel work, brake-beam repairs, air-brake valve repairs, etc., at central points strategically located and have found that this arrangement has many distinct advantages.

The small-tool complement will vary with the type of work and class of cars being repaired. However, there are several units that should be included in all light repair track equipment. We believe that power jacks for raising and lowering loaded cars tops the list. In comparison, hand operated jacks are obsolete, except those of light capacity which are used in jacking empty cars. Furthermore, the efficiency of operation and general safety features makes them almost indispensable. Other small tools, such as air hammers of various capacities, wood and steel boring drills, push and pull jacks, power safety saws, air-brake testing devices, truck hoists, steel trestles and ladders, acetylene and electric cutting and welding units and many others should be included. In addition to these, there are numerous home-made shop devices for specific types of work which should not be overlooked. Previous reports have stressed this feature in particular.

Crane-Type Tractors a Great Help in Car Work

In conjunction with the paved run-ways, we are more than favorably impressed with the use of crane-type tractors. They are very flexible and the operations which can be performed with them are being increased with experience. Their use eliminates the need for material delivery tracks altogether. Heavy material, such as wheels, couplers, truck side frames, truck bolsters, etc., can be transported quickly from stock to the car and excessive strain and lifting by the repairmen and laborers is reduced to the minimum. The crane type tractor is also used to load and unload carloads of material which would otherwise be handled with cranes and the need for their installation is dispensed with.

Other items worth consideration are overhead air lines, electric cables and outlets for electric tools, flood lighting for night work and drinking water facilities. The outlets of these facilities should be placed near the repair tracks where they would be readily available to the employees.

Air lines should be provided with modern valves and leak-proof connections and provision should be made for expansion and contraction, preferably by welded expansion loops. In fact, the entire line should be of welded construction. An electric air compressor of ample capacity, with air storage tanks so located as to maintain a balanced pressure, is essential. First-class rivet work cannot be performed without full specified air pressure.

At points where numerous box cars are cleaned on the repair tracks, the installation of an incinerator would be advisable. Nothing tends to make shop premises more unsightly than paper and other rubbish lying around and being blown about by every gust of wind that comes along.

This subject is of sufficient importance to warrant full investigation on our railroads. We must look ahead into the future and provide better and more facilities for the railroad men of tomorrow.

The report was submitted by R. K. Betts (chairman), foreman car repairs, Pennsylvania.

Inspection and Maintenance of Freight Cars

H. E. Wagner,
Chairman

Recommendations for further action to reduce delays to commodities en route

A. A. R. Mechanical Division General Committee instructions, file GC-1006, were sent out, under date of September 24, 1941, calling attention to needed action to reduce delays to commodities en route. On December 22, 1941, another circular was issued, under the same file, acknowledging the establishment of committees at the important shipping centers and some improvement in conditions set forth in the original circular. However, in reviewing the minutes of these meetings it was found that conditions had not yet improved to the extent anticipated and everyone was urged to intensify his efforts to bring about the desired results.

That their issuance was timely and the recommendations contained therein well founded is evidenced by the findings of this committee, in an analysis of reports submitted by several of the local committees.

The original circular brought out that some of the items listed below required attention as, from reports being received, important freight was being delayed due to failure of supervisors to follow up these matters as closely as the war emergency justified.

1—Selection of cars in proper state of repair and of suitable types for loading.

2—All bad-order empty cars to be repaired to the extent so that they may reasonably be expected to carry their lading to destination without delay enroute for repairs or transfer.

3—Improper loading of cars, i. e., failure to comply with the rules governing the loading of commodities on open-top cars and general rules one to five governing the shipments of freight in closed cars.

4—Shopping of loaded cars for repairs or adjustment that could be safely operated to destination.

5—Failure to comply with interchange Rule 60 in the maintenance of air brakes.

6—Failure to comply with interchange Rule 63 in the renewal of worn brake beams, hangers, pins, bolts, etc., and the application of bottom-rod and brake-beam supports as required in Interchange Rule 3.

7—Improper servicing and repacking of journal boxes as outlined in Interchange Rule 66.

8—Maintenance of trucks, couplers, and draft gear.

9—Expedition of repairs to freight cars, both loaded and empty, to reduce detention time in bad order to a minimum.

Committees were appointed at the important shipping centers and began making inspections of all local facilities, with the view of correcting conditions, in October, 1941. Reports submitted by them, some of which this committee had the opportunity to see, indicated that in many cases there was much room for improvement.

Reports have been submitted covering innumerable cases of open-top loads failing to comply with the loading rules, the principal commodities being steel, pipe, poles, lumber, etc. After reviewing the exceptions found in the reports available, it is evident that the job is still not being satisfactorily done and it would be our recommendation that consideration be given to analyzing conditions at principal repair points to determine:

1—That adequate supervision has been furnished.

2—That all supervisors have been properly instructed to present-day requirements.

3—That through the medium of periodical meetings, questionnaires, etc., employees be given the opportunity of becoming thoroughly familiar with their assigned duties.

4—That the activities of present mechanical committees be increased to such extent that enough inspections will be made to determine if conditions found on original inspection trips have been corrected. Current reports do not reflect that this is being done.

This committee submitted a report to the association during 1942, entitled "Minimum Detention of Cars in Bad Order." Included in that report was a suggestion that the association go on record as favoring the use of a standard form to cover bad-order cars, to enable all supervisors to familiarize themselves with their detention time. That such information is essential is evidenced by the number of cases reported where bad-order cars were unnecessarily delayed and we believe this should again be submitted with the view of bringing about corrective action.

The report was submitted by H. E. Wagner (chairman), master car builder, Alton & Southern.

Passenger Shops and Train Yards

C. P. Nelson,
Chairman

Train yards carry heavy load—Practical suggestions for conserving manpower and material

The lack of manpower, particularly trained and skilled mechanics, as well as essential materials has given car-department officers grave concern in the endeavor to keep rolling stock in proper repair and free from failures. On account of the demand for passenger-carrying equipment, including mail, baggage and refrigerator cars. the regular shopping schedules are again being deferred, comparable with the lean years of the recent depression and as a result a greater burden is thrown upon the terminal yard forces for the various classes of maintenance. The inability to take equipment out of service for the time required to complete general repairs has resulted in the setting up of what might be termed a light general shopping program, the work consisting of a general overhauling of trucks, draft gears, air brakes and a general clean up, performing whatever paint touch-up work is necessary. In this manner, cars are out of service for only a few days and kept "rolling" in a safe and presentable condition.

Management has found it necessary to convert a large percentage of special equipment such as lounge, dining, parlor, observation and even business cars into coaches in order to meet to some degree the demand for increased seating capacity. In some instances, the lounge and smoking rooms in coaches and chair cars have been dispensed with in order to provide additional space for the regulation type coach seat. Also, some of this so-called luxury equipment has been converted into work cars, equipped with benches and used for plant transportation. A large number of box cars have been remodeled into work, bunk and shower-bath cars for various purposes. While some of these changes in equipment appear to be somewhat drastic, nevertheless they are essential and in keeping with the part railroads take in the war effort. Then, too, in making these changes some conception of post-war requirements must be formulated.

The maintenance of passenger equipment in shops and train yards is proving quite a problem, keeping in mind that there is a certain quality and standard to maintain. Supervisors are being called upon to use their ingenuity in devising ways and means to meet their various problems. With the loss of many skilled mechanics through enlistment or induction into the armed forces supervisors have been charged with the responsibility of promoting helpers to the positions and then training these men along with new men to a point of reliability and efficiency. Vacancies for helpers, car cleaners and laborers are being filled in the majority of cases with boys, old men and women, and they also require extensive training. They must be acquainted with the safety rules and thoroughly instructed in accident prevention activities, for, after all, injuries and absenteeism are non-productive. Managements have endeavored to purchase tools, machines and other equipment to place at the disposal of shop and yard forces in order to increase production and conserve manpower. A great many of these facilities are not now available. however, and another bottleneck is encountered.

Practically all of the materials used in the maintenance of passenger equipment comes under the category of vital war materials, a large number of which cannot be obtained. On the contrary, the few materials that can be obtained are finally delivered after considerable delay. Therefore car-department officers and supervisors are confronted almost daily with the task of finding some substitute or investigating new means of reclamation.

The shortage of labor and material is our chief concern for the duration and it is with this thought in mind that we have endeavored to outline briefly a number of the practices already placed in effect.

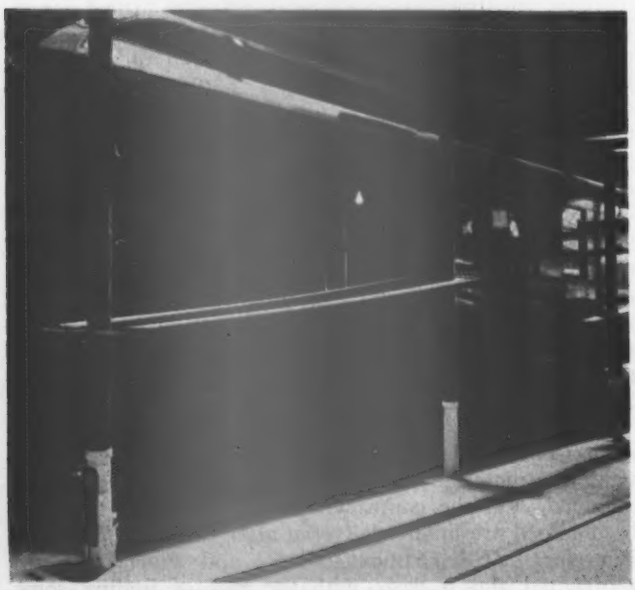
Thirty-Six Suggestions for Saving Manpower or Materials

1—Portable car washing machines which can be used on certain types of equipment are electrically operated and inexpensive to install, being introduced to conserve both labor and material. This machine with rotary brush action operates on a set of rails installed across

a series of train-yard servicing tracks at a designated location, preferably at a point where trains enter the yard from lead tracks. As a train is about to enter a yard on some specific track, the car washing machine is pushed across to the location and washes both sides of the exterior of equipment as it moves through at a moderate rate of speed. If desired, water can be trapped, cleaned and re-used. The machine, operated by two men, one on either side, eliminates the present large number of two- and three-men wash gangs as well as conserving car wash brushes and water hose, both materials being more or less difficult to obtain.

2—Fork lift trucks, capable of lifting 6,000 lb. are being used quite extensively, particularly around shops, for the transportation of mounted wheels to and from wheel shops, storage tracks and drop pits. At one particular point this type of truck is also being utilized for the removal and application of Waukesha engines to passenger equipment.

3—Car-wheel grinders are being used to grind all steel wheels and effect a substantial increase in the total wheel mileage. Extensive study has definitely disclosed that the wheels that have been ground ran far smoother and reduced to a minimum the oscillating movement of the car body, thus preventing to a great extent wear on the superstructure, truck parts such as brake hangers, hanger pins, brakebeams, brakeheads as well as bearings, axles and wheels. It will also tend to reduce hot boxes from waste grabs or broken bearings which occur as the result of the action of an eccentric wheel, particularly on high-speed trains. Tests made of the riding qualities of high-speed passenger equipment has proved conclusively the necessity for concntric wheels. The



Adjustable scaffolding in coach shop with convenient electric outlets on vertical posts

grinding machine effects savings by increasing total mileage between the turning and grinding operations. It will reduce the loss of service metal as compared to the present practice for the reason that the wheel-lathe tool must cut approximately 1/16 in. under the hard surface of the wheel treads. It has been estimated that, with the grinding operation, the life of wheels can be increased at least 25 per cent. In the instances where wheels are tread-worn-hollow the flanges and the shoulders on rim are ground down with practically no loss of service metal from treads. Wheels with flat spots ranging up to 2 in. are all ground.

4—Car pullers are becoming more and more useful as time savers for moving cars in shops and in train-yard repair-track buildings. There are many types of car pullers available and in use, some of which have been designed and built in railroad shops. At one location, a portable car puller is used for spotting of streamliner

Immersion tank used in lubricating air hammers

trains over available pits for wheel changes, etc., thus eliminating the need of motive power for this purpose. This car puller is anchored to a steel ring recessed in a concrete rampway and in using a 1-in. cable this 10-hp. car puller will move a total of 18 units in one train.

5—There is very little to say concerning the motorized tractor as this class of equipment is almost indispensable for the work of handling material on skids or platforms, hauling trailer equipment loaded with usable or scrap materials, propane tanks, ice and rubbish. The various types of tractors and trailer equipment are finding more uses every day in order to conserve man power.

6—Narrow-gauge or industrial tracks are being used around wheel shops, repair-track shops and storage tracks in order to facilitate handling and to conserve man power that was formerly involved in handling wheels with wheel sticks. Abolishing the use of wheel sticks in order to prevent damage to journals is a matter that is being encouraged constantly by the wheel committees.

7—Overhead cranes as well as monorails with chain hoists are being used in the various shops for the handling of heavy materials and thereby conserving labor and speeding up production.

8—The use of adjustable scaffolding in passenger-car shops is steadily increasing in order to facilitate work and conserve labor. Vertical posts are equipped with electrical outlets for use in plugging in electrical appliances, extension cords, lights, etc.

9—Immersion tanks are being used quite generally for the lubrication of riveting hammers. Handles of hammers are submerged in a mixture of 10 per cent kerosene and 90 per cent engine oil after which they are placed in a vertical position in a perforated rack and allowed to drain. This arrangement has reduced the maintenance cost of air hammers.

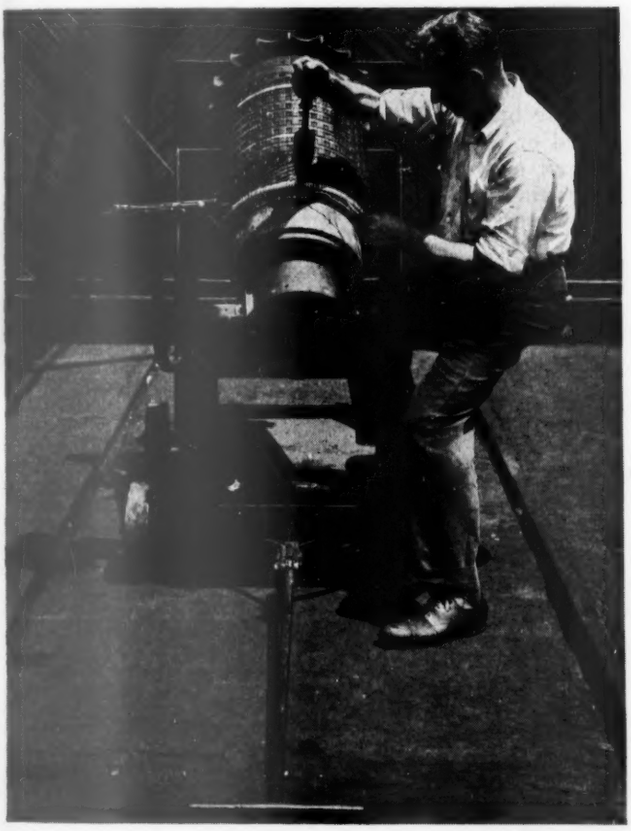
10—A jig is being used to assist in the soldering of

commutators on armatures. It is designed to hold armature for soldering at the correct degree so that solder will puddle at the desired point. Ends of the armature are supported on bearings so that it can be rotated and jig is mounted on wheels for movement about the shop. This method has resulted in substantial savings in labor.

11—Installations of 15-kva spot welder for sheet-metal work on passenger cars has facilitated production in sheet-metal shops.

12—Flexible jigs for welding are being used extensively to position work and increase production. To all metal castings found worn or defective consideration is given as to the salvaging possibilities by welding processes and subsequent treatment.

13—On passenger cars riveted sides, ends and roofs



Jig used in soldering the commutator leads of electric motors

that are worn or rusted through have been replaced in part or whole by welded sections with completely satisfactory results. Vestibule and baggage-car side doors, ventilators, inside trim and many other parts have likewise been profitably subjected to welding.

14—Sheet steel is being substituted for aluminum alloy in repairs to lightweight cars when renewing full sections of skirt sheet. Likewise, body end closing sheets are spliced by using sheet steel, employing a sheet-steel batten (secured with tap screws) over the joint of the dissimilar metals. Aluminum alloy removed and salvagable is cut up in sections and used for patching on this same class of lightweight equipment.

15—Aluminum sash and framing for air-conditioned cars cannot be obtained and one railroad has developed what we believe to be an excellent substitute incorporating the use of double wood sash. The outside sash is secured and sealed to exterior sheets while the interior sash swings on a piano type hinge and is held in closed position with a locking arrangement which is released by a small key or wrench. Dehydrators will operate successfully with these windows.

16—Sanding machines are being used quite extensively, replacing the former practice of sanding sash, etc., by hand.

17—Paint mixers or tumblers, air and electrically operated are being used in paint shops to conserve labor.

18—Owing to the scarcity of mahogany lumber for passenger-car interior finish it has become necessary to substitute white wood for this urpose. Where renewal of mahogany-face ply-wood ceiling panels is found necessary, it has been decided to use pressed wood panels and this practice has developed decided savings in both labor and material.

19—Ventilators on baggage cars are being reduced almost 50 per cent and the excess openings closed, thus reducing the number of ventilators to be repaired or manufactured new.

20—As the top side of side-stem brackets become worn a washer is welded to the worn surface, thereby eliminating the labor formerly involved in sending to the blacksmith shop for removal, reaming and riveting. Also, when a center-stem plate becomes worn a new one is welded instead of riveted to the buffer which saves countersinking, etc.

21—Kinds and sizes of glass are gradually being reduced, consideration being given to substituting less expensive glass for plate. Partially cracked or broken glass is being salvaged and cut into small sizes and used for repairs around buildings.

22—Due to the inability to procure such material as rubber floor tiling, linoleum and carpeting, many railroads are substituting asphalt tile for the floors, including lounge and dressing rooms. This can be obtained in various sizes and colors in order to conform with the individual interior finish of cars and is very attractive, easy to keep clean and has the desired lasting quality under the most severe traffic conditions.

23—Canvas is serving as a substitute when necessary to replace a rubber diaphragm curtain on streamliner equipment. Old sponge rubber removed from seats or used as carpet padding is being utilized for dust-seal boots in vestibules.

24—Galvanized iron has been substituted for copper in the construction of hopper tubes and the lining of way-

A spot welder which helps greatly in connection with sheet-metal work

car ice boxes. Further, in the instances where a double coil of ¾-in. o.d. copper tubing was used in hot-water heaters, one coil of ⅞-in. tubing has now been substituted and is giving satisfactory results.

25—Wood has been substituted for plastic seat caps.

26—An insulating material has been substituted for aluminum bronze for the interior painting of baggage cars, for the trainmen's lanterns in place of tinning and for all interior fixtures that were formerly sprayed with statuary bronze.

27—Welts on upholstered seats and cushions have been dispensed with due to the costly maintenance.

28—White duck has been substituted for burlap on edges of seat cushions and appears to have better lasting qualities.

29—As a substitute for canvas, blue denim material is being sprayed with a rubberized material that is fire proof and then used for engine cab curtains.

30—Felt has been substituted for sponge rubber as weather stripping on sash.

31—In the instance where rattan-covered seats and backs have edges worn, some railroads are applying a strip of Pantasote secured to the rattan with glue and underneath with tacks. This practice is said to have materially reduced the number of claims formerly received from women passengers who damaged their silk hose on the frayed and broken edges of the rattan.

32—In the conversion of parlor cars into coaches, the plush has been salvaged and used for recovering dining car chairs, powder room furniture and seat arm rests.

33—The broken parts of elliptic springs are being replaced and the springs returned to service. Coil springs with a permanent set beyond working limits are also being reclaimed. When these springs are broken the parts are heated and converted into drift pins, punches and other devices which were formerly manufactured from carbon tool steel.

34—Casings of automatic slack adjusters which have become worn are built up by welding, rebored and are returned to service.

35—Pipe, fittings and valves formerly removed from kitchen cars clogged with scale and alkali deposits and then scrapped are now dipped in muriatic acid which removes the scale and then re-used for various purposes.

36—It has been necessary to substitute hard wood for rubber on top of journal boxes to serve as insulation, substitute open-hearth steel three-piece liners for alloy-steel journal box liners and substitute open-hearth steel one-piece liners for alloy-steel pedestal liners.

Too numerous to mention are the many truck parts that are being built up when worn and then either machined or ground, whereas a certain percentage of this class of material was formerly scrapped. Owing to the importance of this class of work, most railroads are making it a practice to send samples of their welders' work to the testing laboratories periodically for analysis. With this in mind, the welders are more exact in performing either acetylene- or arc-welding work.

The report was submitted by C. P. Nelson, chairman, car shop superintendent, C. & N. W.

Report of Committee on Loading Rules

E. N. Myers,
Chairman

Recommendations are made for revisions to four general rules and four figures

Committee No. 8 on Loading Rules has given consideration to all suggestions received during the year, and those which were concurred in are included in the following recommendations for changes in the existing rules. It will be noted that only one recommendation was made for addition to the loading rules, it being our thought that with more intensive supervision at shippers' plants and at loading points, in an effort to have shippers comply with the existing rules, much of the difficulty now being experienced would be minimized and in most cases eliminated.

We believe that if all concerned will put forth every effort to furnish shippers with advice and instruction, to the end that full compliance with the loading rules will be met, a considerable reduction can be made in the number of loads shopped for adjustment.

General Rules

Rule 7—Revision is recommended to indicate that the rule applies to single loads only. *Reason.*—Loads other than single loads are provided for in Tables 1 to 35 inclusive.

Rule 10—Provide maximum height of stakes above cross ties. *Reason.*—To reduce clearance dimensions.

Rule 13—Maximum length of steel slide plate, Rule 13, should be confined to length equal to width of car. *Reason.*—Steel sliding piece should have some support and not extend beyond sliding piece.

Rule 15—Revision of the third par., sec. (b), Rule 15, is recommended to provide for 2-in. band as substitute for the metal filler specified. *Reason.*—Experience has shown that a 2-in. band provides adequate protection.

Figures

Fig. 120—It is recommended that definite specifications be provided in Fig. 120.

Fig. 208-209-209A—It is recommended that revision of Fig. 208-209-209A be made to provide for side and end blocking in addition to anti-skid plates. *Reason.*—Due to number of shipments shopped for blocking where blocking and anti-skid plates were not used.

Fig. 208-209-209B—It is recommended that headings be limited to three tiers and that a weight limitation be put on the pile. *Reason.*—To avoid boxes collapsing.

It is recommended that the committee provide a stake-pocket protector for cable when used. *Reason.*—Experience has shown that protectors are absolutely necessary.

It is recommended that specifications be provided for loading ingots diagonally with car. *Reason.*—To overcome concentrated loads and provide a method not now covered.

It it recommended that rules and figures be reviewed and definite means be provided for securing blocking with nails and bolts where not now shown.

The report was submitted by E. N. Myers (chairman), chief interchange inspector, Twin City Joint Car Inspection Association, St. Paul, Minn.

[This report has been approved by the C. D. O. A. Executive Committee and ordered submitted to the Association of American Railroads for consideration by the Loading Rules Committee.—EDITOR.]

Job Training—Proper Utilization of Manpower

J. E. Keegan,
Chairman

More women must be employed—Specialized job training for new employees

The railroads are today faced with a serious problem—that of filling jobs vacated by employees who have joined the armed forces and of filling additional jobs made necessary by the increased demands now being made on the railroads. The car departments on the railroads have their share of this problem. It has, therefore, become necessary for car department officers to fill many of these jobs with employees having little or no mechanical training as well as with employees who have had no previous railroad experience. Hence, the subject of Job Training and Proper Utilization of Manpower is one which has an important bearing on freight- and passenger-car maintenance, the topic formally assigned to Committee No. 2 for consideration.

Increased employment of women is necessary. This is being done by many railroads with marked success. A few of the jobs in which they are now being employed are upholsterers, machine operators, crane operators, turntable operators, machinist helpers, carman helpers, electrician helpers, car oilers, stores attendants, passenger-car cleaners and messengers. It is generally found that they are interested in their work and if properly trained, are doing their share toward the successful operation of the railroads and the successful outcome of the war. In questioning women applicants it is often found that they are enlisting in railroad service as a patriotic duty, having husbands, brothers or sons in the armed forces who were formerly employed with the railroad. Such women employees, if physically and mentally fit, prove to be valuable additions to the ranks of railroad workers.

Owing to the present emergency, it becomes necessary to train employees in as short a time as possible. On account of this situation, it cannot be expected to create mechanics, as we know them in normal times. It is therefore advisable to train employees to specialize in certain mechanical jobs. The first essential is the proper selection of the trainee. Careful selection of applicants, based on their qualification, will result in more satisfactory and satisfied employees. Earnest desire and ambition on the part of the trainees is of prime importance if these jobs are to be successfully filled.

The proper training of employees is the duty of supervisory personnel. The new employees must be taught to do their jobs correctly, quickly and safely. The training period must necessarily be as short as possible. The principle of the Training Within Industry plan developed by the Federal Commission has been adopted by various railroads and is proving successful in training employees in a remarkably short time. Under this method classes in job instruction are held which are attended by the supervisor. These classes are conducted by a trainer who teaches the class a quick sure method of instructing new employees. The employee must first be told how to do the job, then shown. This must be repeated until the instructor is satisfied that the learner is ready to attempt the job. The learner must then demonstrate to the supervisor that he is able to perform the job in a satisfactory manner. The practice of assigning a new employee to an experienced employee for a period of time and then expecting him to do the job successfully must be forgotten.

Specialized Job Training Is Essential

As stated earlier, there is not time to develop employees into full-fledged mechanics. It, therefore, becomes necessary to train them to perform a certain definite job in a satisfactory manner. The employee thus becomes an expert on that particular job and he should be employed on that particular job instead of being continually transferred to jobs with which he is not familiar.

Because of the shortage of manpower it is necessary to retain all present employees to the greatest extent possible. It may be that the first job to which an employee is assigned is one for which he is not fitted and to which he cannot adapt himself. When this condition arises the employee, if possible, should be given an opportunity to try other jobs until one is found which the supervisor feels can be handled by the employee satisfactorily, at which time the thorough training should be given. It is important that every effort be made to

prevent a large turnover in forces. Every new employee requires a training period, which lowers efficiency and output. Working conditions should be given full consideration and should be maintained on as high a level as possible. The handling of questions, objections and grievances should be judiciously done. Suggestions for the betterment of conditions, improved methods of performing jobs and development of better procedures should be encouraged. Enthusiasm among employees should be encouraged and maintained.

Importance of Conserving Manpower

Waste of manpower must be avoided. It is the duty of the car-department supervisor to know that manpower is not being wasted by the use of more employees on a job than are necessary for the satisfactory completion of that job. Careful study of the job is necessary to accomplish this.

The question of safety should be given as much consideration as the mechanical training of employees. Because new employees of today are generally totally inexperienced in conditions found on railroads, the man hours lost due to accidents has increased alarmingly. The employees must first be taught the importance of proper dress. They must be impressed with the necessity of performing their duties in a manner that will be safe for them and for their fellow employees. On some railroads the gang supervisors or gang foremen hold daily meetings in the morning prior to starting time of their shops at which time the question of safety is discussed and impressed on the employees.

These are but a few of the many problems concerning the car department officers of the American railroads and which they must solve as their part in winning World War 2.

The report was submitted by the chairman, J. E. Keegan, chief car inspector, Pennsylvania.

Report on Car Interchange and Billing

E. G. Bishop,
Chairman

Rule 9

The committee recommends an additional sentence be added to Rule 9, A. A. R. Code of Rules, Page 38, Use of Billing Repair Cards, Air hose, applied.

Proposed Form: New or second-hand, or spliced per A. A. R. Specifications. *Letters S. P. S. may be used to indicate spliced per A. A. R. Specifications.* Cause of removal. Item number as outlined in Rule 56 may be used to indicate cause of removal.

Reason: To eliminate writing on billing repair cards.

Rule 16

The committee recommends that Par. 4, Rule 16, be changed as follows:

Proposed Form: A road having in its possession an empty tank car due for the test of *tank or* safety valves *or both* must make such tests in accordance with the I. C. C. Regulations (*Set Interpretations 1 and 2 of Rule 3*) billing the owner for the cost of same. *Such tests may be made* within thirty days in advance of expiration of the time limit for such test or on account of illegible stenciling.

Reason: Testing of tanks should be handled in same manner as safety valves, as it relates to expiration periods. (Reference to Rule 3 Interpretations 1 and 2 added for convenience.)

Rule 17

The committee recommends change in answer to Interpretation (M-9), Rule 17.

Proposed Form: Q. Does the substitution of a rolled steel channel or heavier pressed steel spring plank in place of a pressed steel spring plank, constitute wrong repairs?

A. No, providing spring plank applied has sufficient clearance for truck bolster and otherwise conforms to standard of car. Charge and credit should be on basis of material applied and removed, *however, the substitution of pressed steel spring channel, when rolled steel channel is standard to car, is wrong repairs, and defect card must be issued for labor and material.*

Reason: Not generally understood that such wrong repairs weakens the structure of car, and is therefore considered as wrong repairs.

Rule 18

The committee recommends Par. (b) (2) Rule 18 be amended.

Proposed Form: (2) In the application of second-hand or reconditioned coupler bodies or complete coupler, the shank shall be not less than 21 in. in length from striking horn to crest of worn surface of butt, nor less than 3⅞ in. from pulling (rear) surface of horizontal key slot to crest of worn surface of butt, established with parallel straight edges (see Fig. E), *the shank wear, due to contact with the carrier, must not be in excess of — inch.* Coupler bodies having such minimum dimensions shall not be removed from cars for these defects alone, but if removed for other reasons and otherwise serviceable same shall be credited at *scrap* value.

Reason: To insure the application of suitable couplers, so far as concerns shank wear, warranting second-hand price being charged. This limit to be established by the A. A. R. coupler committee. Establish scrap credit, instead of second-hand, as a matter of equity, so that repairing line may recover expense of reclamation.

The committee recommends Par. (b) (3) Rule 18 be amended.

Proposed Form: Coupler bodies having cracks within the shaded area shown in Fig. D must have the cracks welded when applied to foreign cars. Coupler bodies having cracks within the shaded area shall not be removed from cars for this defect alone, but if removed for other reason and if otherwise in serviceable condition same shall be credited ——— value.

Reason: Reference in the present Rule to note (c-l-b) is erroneous, as the note has been removed. Change in credit allowance recommended in order to set an equitable price for reclamation.

The committee recommends that a new paragraph be inserted in Sec. (c) Rule 18.

Proposed Form: Recommend new paragraph be inserted in Sec. (c), specifying limits for removal of coupler bodies from service for the defects mentioned in Par. (b) (2).

Reason: To remove from service coupler which may be dangerous.

Rule 23

The committee recommends "Coupler Yokes" be inserted in Par. 7, Sec. A, Rule 23.

Proposed Form: 7. Marking Welds.—When truck side frames, bolsters, *coupler yokes,* or knuckle side wall of coupler heads are welded, a record must be stamped by at least ⅜-in. steel stencils on the weld or immediately adjacent thereto to indicate railroad reporting marks, date, shop identifying symbol and welders identification number or mark, arranged in the following form: Reporting marks, A B C 10-31-41. Date; shop identifying symbol, AV 72. Welder's mark.

Reason: To conform with Rule 23 Par. (gi-9).

Rule 32

The committee recommends the word "body" be inserted in Par. (10) (f) Rule 32.

Proposed Form: (10) (f) Pushing car *body* over bumping post or other obstruction, or striking overhead fixed obstruction.

Reason: Clarify what is believed to be the intent of the rule.

Rule 98

The committee recommends note be added to Sec. (i) Rule 98.

Proposed Form: Add note to section (i) Rule 98 reading, "One-wear wrought steel wheels removed for vertical, thin, or high flange are not subject to reclamation unless the total tread thickness is at least 1 1/16 in. before turning."

Reason: For information of railroads not acquainted with this reclamation, it being our information that the Wheel Committee in conducting a study has found that unless there is at least 1 1/16 in. total tread thickness before turning that it is impossible to turn them and keep them within the minimum dimensions.

The committee recommends the following questions and answers be added to Interpretations (i) Rule 98.

Q. In the event of one 1-wear wrought-steel wheel having vertical, thin, or high flange, and total tread thickness less than 1 1/16 in. before turning and the mate wheel condemned by remount gage, but having total tread thickness of at least 1 1/16 in., the wheels would be dismounted and the latter wheel set aside for reclamation by turning. How should this reclaimable wheel be credited when removed from car inasmuch as its actual turning has to be deferred until suitable mate wheel can be obtained?

A. In such case, the reclaimable wheel referred to may be credited on basis of having 2/16 in. of service metal after turning as an arbitrary proposition to cover such individual cases, rather than hold up the bill until the wheel is actually turned. It must be understood, however, that such arbitrary proposition will not apply where the wheels are reclaimed without dismounting from axle.

Reason: To facilitate prompt billing, eliminating the necessity of holding the wheels at wheel shop for excessive length of time until mate wheel can be found.

Q. Where a one-wear wrought-steel wheel is condemned account vertical, thin, or high flange, but is reclaimable, and the mate wheel is not condemnable by any gage, shall the latter wheel be reclaimed by turning so as to correspond with the mate which is reclaimed by turning?

A. No. In such case the wheels shall be stripped from axles and the wheel not condemnable by any gage credited as second-hand and so reused by remating with another secondhand wheel.

Reason: To establish correct wheel shop practices, principally with the thought in mind of the conservation of critical material.

Rule 101

The committee recommends "Coupler Yokes" be added to Weights of Miscellaneous Items.

Proposed Form: Coupler yokes, wrought iron and cast steel 18½ in. and 24⅝ in. pocket.

Reason: To facilitate the preparation of billing repair cards and save labor on repair track obtaining scale weights.

Note: Weight for these types of yokes to be determined by A. A. R. Price Committee.

Form for Original Record of Repairs

The committee recommends elimination of the note at the bottom of the form entitled Association of American Railroads Original Record of Repairs (Interchange Rules, page 274).

Reason: The note, as written in its present form, is misleading inasmuch as it does not specify all information to be shown on the original record required in other rules, such as Rule 104 (1), etc.

Passenger-Car Rule 8

The Committee recommends (17) (e) be modified, P.C. Rule 8.

Proposed Form: (e) Journal cut, or requiring reconditioning due to heating, on friction bearing units; *except where lubrication device other than waste packing is used;* axles bent; or axles damaged as provided in Par. (a). When necessary to true up axles in case of cut journals, if journal is reduced below the limit as prescribed in Rule 7 (e), axle must be changed at the expense of the delivering line.

Reason: Various devices more or less in the experimental stage are being used, and it is thought that a car owner desiring to experiment shall do so at their own expense.

Index

In this committee's report for the year 1941 a partial report was made in connection with recommendations for revision of index to the A. A. R. Interchange Rules. Since that time and up to the present this matter has been actively progressed. We are now submitting our draft of complete revision of the index.*

Sec. I is the proposed revision, and Section II is the

* Not included in this abstract of the committee report on account of space limitations.

present form as outlined in the book effective January 1, 1943.

It is estimated that the proposed form will require 19 pages in the rule book. Your committee regrets that it was not possible to confine their proposal to the limit of 12 pages as recommended in their instructions.

This draft is being submitted in the hope that the Arbitration Committee of the A. A. R. Mechanical Division will be able to reconsider their decision regarding the amount of space which the index should occupy, as your committee feels that with the amount of inexperienced help which must be used both in billing offices and in the field it will be a big advantage to have this index as comprehensive as possible.

The revision of the index is almost entirely the work of D. E. Bell, A. A. R. Instructor, Canadian National, vice-chairman of this committee, and the entire Committee, recognizing the volume of work and the thoroughness of this index revision, express their appreciation to Mr. Bell and pass on to him full credit for the accomplishment.

The report was submitted by Chairman E. G. Bishop, general foreman car department, Illinois Central.

[This report has been approved by the C. D. O. A. executive committee and ordered submitted to the Mechanical Division of the Association of American Railroads for consideration by the Arbitration Committee.—EDITOR.]

Painting Freight Cars

The report reviews painting procedure for the protection, inside and out, of steel cars

L. A. Hartz,
Chairman

As most equipment is built of steel, it is only fitting that we give some thought to rust and corrosion and causes contributing to its formation on these metals. According to most accepted theory, rusting is an electrochemical process affecting most steels as they are not pure substances of perfectly uniform structure. Ordinary open-hearth steel contains small amounts of carbon, silicon, sulphur and phosphorus. These substances are in various states of combination within the metal and vary in its physical structure. Nearly all these substances are soluble in water to some extent and although the amount of solution may be very small it is readily apparent that this condition is ideal for the interplay of electrical potentials whenever water or water vapor is present. The solubility of these substances is increased if the water contains traces of gases, salts or acid. Thus iron dissolving from a paint on the surface will form ferrous hydroxide which changes to iron oxide in the presence of air. This is the familiar reddish brown substance which is called rust.

As closed-top hopper cars come to the shops for repairs, inspection is made and if cars are badly corroded they are sandblasted, both interior and exterior. The cars are then sprayed with red-lead primer, in some cases read-lead-chromate primer. Most railroads use no paint over the primer.

Prior to the war it was possible to obtain a rubber pigmented paint which stood up very well in this class of equipment.

The exterior is sprayed with an acid-resistant paint. The underframes and ends are sprayed with car cement. A car that is not badly corroded has the rust spots cleaned off with an air-driven wire brush. The spots are then spot primed and car is now ready for paint. These cars are painted every two to three years, depending on the commodity handled in them.

Open-top hopper cars are taken into the shop, stripped and sent to the sandblast. They are then sprayed with red lead or red-lead-chromate primer. The underframes are sprayed with car cement or a non-corrosive primer. After the cars have passed through the repair shops and are ready for painting, all new metal is primed with red lead or red-lead-chromate primer, over which two coats of standard specified paint are applied. Some railroads use no primer, applying two coats of gondola black paint.

One railroad has in service a number of open-top hopper cars which are being used in the hauling of sulphur only. These cars had the interior metalized with aluminum using an acetylene metalizing gun for this application. They have been in service for two years and are holding up satisfactorily. This method is not now available, because it is being used extensively to protect the bottoms of ships. Open-top hoppers are painted every two or three years, and in some cases more often on account of frozen loads being thawed with torches to make hoppers operative.

Painting the Interiors of Steel Box Cars

Steel box cars are all lined with wood sheathing with the exception of the roofs which are in most cases, galvanized iron. Over this has been sprayed an asphalt and cork moisture-repellant mixture, which has been successfully used in combating condensation so prevalent on a metal ceiling, with so many commodities carried in these cars from cold to warm climates. The cars are washed down, repaired, and a coat of varnish sprayed over sides and ends. This class of equipment carries the highest grade of commodities, such as flour, grain and other food products which must be carefully kept from becoming contaminated while in transit.

The report was submitted by L. Hartz (Chairman), foreman painter, Illinois Central.

Locomotive Maintenance Correspondence Forum

J. E. Goodwin, President

C. M. Lipscomb, Sec.-Treas.

The L. M. O. A. sponsors roundtable discussions of six timely problems —Supplemented by a study of the railway machine tool situation

THE leaders of the Locomotive Maintenance Officers' Association decided early this year that because of the pressure under which the members of that organization are working, it would hardly be advisable to attempt to carry on committee work during the current year. On the other hand; there was a pronounced feeling that never was there a time when it was more important for the members of the association to give thought and study to the many difficult problems and situations involved in attempting to keep the motive power in prime condition, with the shortage of critical materials and manpower.

Meanwhile, the rather remarkable success that has followed the Roundtable discussions inaugurated by the *Railway Mechanical Engineer* last April, suggested the idea that the equivalent of committee reports in a "Convention-in-Print" could be achieved by having the Association sponsor a series of intensive roundtables, through correspondence, of a number of questions of special interest, a solution or better understanding of which would be helpful at this time. The fine spirit in which railway mechanical officials participated in these Roundtables is a matter of deep gratification.

The editors of the *Railway Mechanical Engineer* have supplemented this with a study of the machine tool requirements on the railways, which was made possible through the generous co-operation of the railway mechanical departments.

Officers of the Association

The officers of the Locomotive Maintenance Officers' Association are: President, J. E. Goodwin, assistant chief mechanical officer, Chicago & North Western, Chicago; first vice-president, F. J. Topping, master mechanic, Chesapeake & Ohio, Hinton, W. Va.; second vice-president, S. O. Rentschler, mechanical superintendent, Southern district, Missouri Pacific, St. Louis, Mo.; third vice-president, C. D. Allen, master mechanic, Chesapeake & Ohio, Silver Grove, Ky.; and secretary-treasurer, C. M. Lipscomb, assistant to production engineer, Missouri Pacific, North Little Rock, Ark. The members of the executive committee are F. J. Topping (chairman); George Crowder, superintendent motive power, Georgia & Florida, Douglas, Ga.; W. P. Buckley, shop superintendent, Chicago, St. Paul, Minneapolis & Omaha, St. Paul, Minn.; W. E. Vergan, supervisor air brakes, Missouri-Kan.-Tex., Denison, Tex.; G. A. Silva, supt. locomotive maintenance, Boston & Maine, Boston; and G. E. Bell, gen. for. Ill. Cen., McComb, Miss.

The association's advisory board consists of P. O.

Christy, general superintendent equipment, Illinois Central, Chicago; D. S. Ellis, vice-president, Lima Locomotive Works (formerly chief mechanical officer, Chesapeake & Ohio, Pere Marquette and Nickel Plate); O. A. Garber, chief mechanical officer, Missouri Pacific; J. Roberts, managing director, National Railways Munitions, Ltd. (formerly chief of motive power and car equipment of the Canadian National Railways); and Daniel J. Sheehan, superintendent motive power of the Chicago & Eastern Illinois.

Roundtable Discussion on Flame Hardening

Question—Have you used flame hardening on locomotive parts? Has this process helped to solve material shortage problems?

Anticipates Longer Life Of Parts Subjected to Wear

It was not until a short time ago that the Boston & Maine started to experiment with flame hardening. The first step was the construction of a machine which could adequately take care of the great variety of work naturally associated with the back shop. The machine, constructed in the shop, was built after plans supplied by the vendor, with few changes.

Up to the present time experimental work has been done on crosshead guides, radial buffers, chafing irons, stoker conveyor screws, stoker screw racks, spring saddles, motion links, lead truck rockers, gun iron shoes and wedges, valve crosshead guides, valve guide plates, valve crossheads, union link pins, driving box wearing plates and hammer dies. Plans are being made to flame harden multiple wear guides as soon as special heads are available.

Considerable work has been done on guides to determine deformation and necessary corrective heating, but as yet definite conclusions are not available. On valve crossheads it has been found most advisable to first harden the sides, which have the larger surfaces, and then the top and bottom, being careful to raise the flame while passing over the combination lever middle pin hole. By following this procedure, the hazard of cracking is greatly reduced. Some of the work has been done on material built up with Oxweld M & W steel, which seems to respond quite well to the treatment.

In working with various kinds of material it has been found that cast iron responds most favorably to flame hardening, and at the present time seems to present the most promising field.

As to the shape of the work hardened, a certain amount of trouble has been encountered with thin sections, where deformation has been quite considerable at times. On large bodies there has been almost no trouble of this kind.

Of considerable interest has been the flame hardening of No. 4 Nazel hammer dies. Dies so treated have stood up with negligible wear for a considerably longer time than the conventional die.

Aside from the work on dies, we have nothing to report on wear characteristics of work flame hardened in our shop, as the service has been too short. We are constantly changing our procedure and should soon have developed a quite satisfactory set of data from which to develop interesting conclusions. All the work enumerated above has a large bearing on the saving of material. We are anticipating long life of flame hardened parts.—*W. H. Ohnesorge, Shop Superintendent, Boston & Maine, North Billerica, Mass.*

Results Demonstrated

We are working on and making up a flame hardening set-up for our smith shop. We expect to have it completed and installed shortly.

However, we had a demonstration within the past year by the Oxweld Railroad Service Company, at which time we flame hardened the following: Steam hammer die block, top and bottom guides, two stoker screws, stoker pinion gear, stoker gear, spur gear, spring saddle, rocker seats for engine truck, and valve crosshead.

I believe that steels that contain at least 0.35 per cent carbon and over can be successfully flame hardened. After all, flame hardening is only surface hardening and the surface to be treated must be free from seams and laps, pits and blow holes. If we hold our flame hardening to machined steel parts, such as links, link blocks, wrist pins, knuckle pins, valve crossheads, engine truck rocker guides, guides, cradle hangers, gears, etc., I feel that longer wear resulting in less frequent renewals of parts will be obtained.—*E. A. Koschinske, Superintendent of Shops, D. L. & W.*

Used Extensively on T. & P.

We have had flame hardening equipment in use at our shops at Marshall, Tex., for several years. We are continually making

Operations Using Oxweld Flame Hardening, Texas & Pacific

Operation	Brief Description	Remarks
Harden top and bottom engine truck and trailer rocker seats	Machine to undercut seats, build up with ¼ inch "MW" steel and harden to 500-575 Brinell	Originally necessary to renew on heavy power each shopping. Engines returning to shops with flame hardened seats in good condition
Harden wearing surface of passenger car truck bolster wear plates	Cut spring steel 6 inch x 8 inch and harden one side to 550-600 Brinell	Wear plates of flame hardened material on cars returning to shop are in good condition. Originally necessary to renew each shopping
Passenger car center plate wear liner	Cut boiler plate ring on shape cutting machine. Specially treat by packing in box of Quicklite case hardening compound and heat 5 hr. at 1600 deg. F. Remove from furnace and let cool in box before removing. Flame harden to 500-550 Brinell and grind to smooth surface.	Rings now under test made in this manner. Original steel rings galled
Flame hardened knuckle pins and case hardened bushings	Knuckle pin flame hardened to 500-550 Brinell. Bushing pack hardened	Knuckle pins and bushings now under test on several engines. Reports indicate satisfactory performance
Driving box hardened steel hub liner on wheel center	.45 to .50 carbon steel liners flame hardened to 500 Brinell	Several engine sets applied with good results
Hardening of teeth in ratchet track jacks	Build up teeth with Oxweld "MW" steel and harden to 650 Brinell	Previously built up lip with "MW" steel and not hardened
Manufacture of hardened flue rumbler bands	Flame hardened band for use in removing scale from flues	Originally purchased from manufacturer. Necessary to replace every few months. Flame hardened bands now in service 2 years
Manufacture of gear for pile driver	Scrap axle steel flame cut out on flame cutting machine and teeth flame hardened	Several gears in service giving satisfactory service. One such gear bought new cost $195 from manufacturer. Cost of gear as made was $21.00
Flame hardened links for test of roller bearing link block	Flame harden link block bearing surfaces	Test now being conducted
Flame hardening of valve crossheads and crosshead guides	Cross heads and guides flame hardened to 500-550 Brinell	Several engines now equipped with good results
Flame hardening of guides	Flame hardening wearing surfaces of main crosshead guides	Standard practice. Results satisfactory

use of this machine on locomotive and car parts, as well as on parts of work equipment. We have found the practice of flame hardening parts materially increases the life of the part, decreases maintenance cost, and also assists in solving the shortage of material problem. Accompanying this is a list of a number of typical items on which we have secured very satisfactory results.—*J. J. Prendergast, Mechanical Superintendent, Texas & Pacific.*

Wear is Reduced On Critical Parts

Flame hardening is the name given to a heat treating process which hardens the surface of metal to a depth of 1/16 inch to 1/8 inch. The center, or core, of the piece is not altered in any way.

The fundamental principles of flame hardening do not differ in any way from any other method of hardening. The first and most essential requisite for any hardening process is the chemical composition of the metal to be hardened and this may be expressed as the "hardenability" of the metal.

We have applied flame hardening to sections of parts requiring surface hardness and a tough, ductile core; such parts as gear teeth, engine truck rockers and seats, trailing trucks and seats can be successfully flame hardened on the wearing surface provided the carbon content of the steel is in the vicinity of 0.35 per cent. This carbon element is the principal hardening element in steels and in the plain carbon steels the carbon content must be 0.25 per cent or above, before any appreciable hardenability can be obtained. Alloys may be added to increase the hardenability of the steel and these alloying elements may be added individually or in combinations of two or more. The most commonly known alloying elements used to increase the hardenability of steel are chromium, manganese, tungsten, vanadium and molybdenum. Nickel and silicon will increase the hardenability to some extent but they are principally toughening elements.

In flame hardening, the carbon content of the steels as a whole must be sufficiently high to harden; a low carbon steel cannot be hardened by flame hardening. Also, in flame hardening as in any other method of hardening, severe stresses are set up by the rapid quench, and these stresses are often sufficient to cause warpage. When heat is applied rapidly, thermal checks will result; these checks often progress and cause failures, and all of this must be given close consideration in the selection of parts for flame hardening.

We have in the past and are now applying flame hardening to such items as driving box saddles, engine truck rockers and seats, trailing truck rockers and seats, as these are the only items for which we have jigs and suitable tips at this time.

However, even these few items to which we are now able to apply flame hardening have effected a considerable saving of critical material for us, in that it has reduced the wear on these critical parts.—*S. O. Rentschler, Mechanical Superintendent, Missouri Pacific.*

Alleviates Material Shortage

We are now flame hardening the following locomotive and car material with good results: Guides; wearing parts on engine trucks; tender equalizers for 4-8-4 type (Class T), 2-10-2 type (Class R) and 4-6-2 type (Class K) locomotives; chafing castings between tender and engine; stoker conveyor worms and spring saddles. It is felt that this flame hardening has contributed to some extent in alleviating the material shortage.—*A. H. Mitchell, Superintendent Shops, Lehigh Valley, Sayre, Pa.*

Roundtable Discussion on Engine Terminals

Question—Has any improvement been made in reducing the turning time of locomotives in your terminal in recent years? What facilities or methods have been responsible for this improvement?

Speeding Up Operations

For a number of years, a campaign has been carried on to reduce locomotive terminal time at all major terminals of the New York Central, to keep the power in actual road service as much of the time as possible and reduce the number of units in service to a minimum. This program served as a training period prior to the emergency, and has proved invaluable in handling the present business.

Formerly, the terminal facilities were thought adequate to handle the power rapidly. However, with nearly double the number of dispatchments, it is recognized that some changes, such as additional cinder pits and trackage in terminal territory, could be made which would speed up the handling of this extra load. Due to material and man power shortages, these improvements are out of the question at this time, and the situation must be met by taking up all the slack and speeding up the maintaining procedure.

Locomotives arriving on the coal dock are looked over immediately by the machinery and air brake inspectors, who phone their report to the work report clerk. The incoming engineer is required to make his report immediately on arrival. Thus the work report is completed as soon as possible, in order that the dispatching foreman may have this information well in advance of the locomotive coming into the house, thus giving him time to line up his forces for the necessary repairs and servicing. He can also give an early estimate as to the time the locomotive will be available for service.

A hostler, stationed at the coal dock, assists the inspectors in testing for pounds, steam leaks, etc., and when inspection is completed, he supplies the locomotive with sand, coal and water and delivers it to the cinder pit.

All fires are dumped on main line power to permit inspection of flues and firebox, as normally locomotives dispatched run from two to six divisions before entering another terminal. The boiler inspectors or hot men enter the firebox as soon as the fire is dumped, make a close inspection and take care of any minor repairs necessary, including cleaning off the flue sheet, hooking out flues that may contain clinkers, and making repairs to the arch.

The success of this program depends on the ability of the dispatching foreman to plan his work and instruct his forces so that his plans are carried out smoothly and all the slack is taken up as the locomotive progresses from one operation to another from coal dock to ready track. A well balanced, thoroughly instructed terminal force under an alert, capable foreman who knows what he wants and understands how to make his wants known to his men, produces surprising results. An average terminal time of four to five hours per locomotive during a twenty-four hour period is not uncommon. This average includes washouts, flue blowing and any other work requiring more than twenty-four hours to complete, so in many cases locomotives leave the ready track in one and one-half to two hours after their arrival.

Another highly contributing factor in reducing terminal time is the amount of work performed at monthly and quarterly inspections. A policy of close inspection and extensive repair at the time locomotives are cut out at these periods puts them in condition to run through the intervening time with very little attention of a time consuming nature.—*R. F. Batchman, Asst. General Foreman, New York Central, Toledo, Ohio.*

"A Stitch in Time Saves Nine"

There are several items that enter into the turning of engines at terminals, such as the program of quarterly tests for rods, pistons, crossheads, valves, etc., which parts are removed and sent to the main shops, where they are Magnua-fluxed and worn parts replaced. Stokers, drawbars, injectors, boiler checks, etc., are cleaned, inspected, and the necessary work performed. Engines are serviced not at the time of despatch, but when they arrive from the cinder pit. Washing of super-

heater units has reduced the maintenance, in that the sludge build-up in the units is removed at the time of each washout period. With the power in good condition, under the above program, it is now possible to turn an engine in 30 minutes by cleaning the fire and servicing the engine on the despatch track.—*Foreman.*

Factors That Have Demonstrated Their Value

There has been the greatest improvement made in reducing the turning time of locomotives in this terminal in recent years, due to the application of roller bearings on freight and passenger engines, locomotive and tender.

The force feed lubricator, as applied to Missouri Pacific engines—both passenger and freight—has been another important factor in reducing the turning time of locomotives and allowing us to get more miles in the aggregate per month. Also there must be taken into consideration the reduction in the roundhouse running repairs brought about by proper force feed lubrication.

New power, with complete roller bearing applications, is also equipped with the 4-in. superheater tubes where type E units have been used; this is one of the greatest improvements that could be made to a locomotive. The change from 3½-in. to 4-in. tubes makes possible several round trips between St. Louis and Kansas City in fast freight or passenger service, without boring flues.

Another factor of prime importance, which has been responsible for cutting down the time the locomotives are held out of service in the engine house, is the provision of adequate drop pits.

The Lidgerwood as used and properly handled in the turning of tires, with a competent man in charge of the work, has reduced the time out of service of our passenger and freight locomotives.—*Joseph M. Whalen, Master Mechanic, Missouri Pacific, St. Louis, Mo.*

Roundtable Discussion on Finishing Cylinders

Question—Which is better—boring, grinding or honing—such parts as air brake pumps, feedwater heater pump cylinders, reverse gear cylinders, etc.? Why?

Is Honing Necessary?

Honing is a super finish for grinding, but is it necessary? Grinding gives an excellent finish and leaves microscopic areas for the oils to cling to. Our pumps under normal operating conditions run their mileage and are in good condition when dismantled. Ring wear is very slight, which proves they must be moving over a smooth surface.—*Machine Shop Foreman.*

Grinding, Accurate and Smooth

We are grinding our air brake pumps and feedwater pump cylinders, as well as our reverse gear cylinders, and we feel this is more accurate and a much smoother finish than the boring.

We do not have a honing machine of sufficient capacity to do this same class of work, but personally I feel the honing is one step further in the perfection of the work performed.—*Bernard Cook, General Foreman, N. & W., Roanoke, Va.*

Favors the Boring Process

Although we grind such parts as air pump cylinders, feedwater heater cylinders, reverse gear cylinders, etc., in some of our shops at present, I am advocating the following practice which we have tried out and found entirely satisfactory.

On compound air pumps we place the pump cylinder attached to the center casting on a revolving table on a horizontal boring mill, and use a double spindle boring bar which is geared to drive both spindles at the same time at the correct speeds for the large and small cylinders and pilot the bar through the stuffing boxes; if these are out of line, we true them up. The pump is set true with the proof lines on the cylinders at both ends by checking with the spindle at the front end and the back end with the outer support. The cylinders next to the spindle are bored first. The table is then revolved and set true with the bored cylinder from the outer support by using a plug in the outer support bearing, to which an indicator is attached. After this is done the table is locked and the other cylinders are bored. We then lap all four cylinders with an expansion lap. This method is faster than grinding and we have increased the mileage on our pumps, as compared with other methods. The finish obtained in the cylinders by this method is equal to, if not better than grinding.

The lapping is done on the horizontal boring mill by the use of a shop-made expansion lap, which automatically centers itself and gives us a perfectly round hole and parallel full length of bore.

The same method can be used on the other type of equipment referred to.

The reason for this method being an improvement is that stock necessary to remove is taken out faster than grinding and although a boring tool can be used on a Micro grinder, it is a slow operation as compared with using a horizontal boring mill, where you have the necessary power and feeds. Carboloy is used to further speed up the boring operation.—*J. I. Stewart, Supervisor of Shop Machinery and Tools, N. Y. C.*

Manufacturer Prefers Boring

It is our experience that boring is the preferable process in finishing the cylinders of air brake pumps for the following reasons:

We, as manufacturers, must start with a rough casting and this, of course, requires boring, initially, irrespective of the finishing process. By the boring of parallel cylinders simultaneously, the matter of holding to center tolerances and alinement is simplified from that which would obtain, should grinding one cylinder at a time be practiced. Railways, when maintaining these units, have the center spacing set for them, that having been determined by the manufacturer, and their only interest is in truing up the diameter. They can, then, grind or hone where it would not be feasible for us to do so. We have no difficulty in holding to the limits of plus five thousandths and minus zero, and the surface finish which we obtain is giving satisfaction. Therefore, we feel that to change from the boring process would be economically unjustified.—*L. K. Sillcox, 1st Vice-President, The New York Air Brake Company.*

The Smoother, the Better

Honing, grinding and boring, in that order, in our opinion, are the best methods of finishing bores of cylinders on reverse gears, feedwater heater pumps and air compressors.

Basically, to reduce wear it is necessary to maintain an oil film between the surfaces in contact. An oil film can be maintained most effectively on a smooth finished cylinder bore. An evidence of the value of smooth finishing has been demonstrated by results obtained from "super-finishing". The smoother and better finished cylinder will prolong the life of the piston packing.—*K. D. Read, Asst. Supt. Locomotive Shop, N. Y. C., Beech Grove, Ind.*

Considers Grinding Best

We consider the grinding of air brake pumps, feedwater heater pumps, cylinders, reverse gear cylinders, etc., superior to boring, for the following reasons:

1—The frequency of dismantling air cylinders and center pieces on air compressors is very much less than the dismantling when the boring bar is used.

2—Less material taken out of the cylinders at the repair periods, due to the finer adjustment of the grinding wheel.

3—No trouble to fit pistons and rings, due to the fact that ground cylinders are perfectly parallel, resulting in increased life of air compressor between shopping periods.

4—Increased output of pressure has been proved by average orifice tests which have been made on air compressor test racks.

5—Less time is taken in testing air compressor. At times it is necessary, after fitting pistons and rings closely to a bored cylinder, to run the pump six or eight hours. For ground cylinders, closely fitted pistons and rings, one-half to one hour is all the time necessary for running in an air compressor with ground cylinders. This also concerns feedwater heater pumps.

It is very necessary to maintain cylinders of the reverse gear to as close a limit of 10 in. as possible, to take care of a standard 10-in. packing cup. This can only be accomplished by the grinding method.—*A. H. Williams, General Supvr. Apprentice Training, Canadian National.*

Roundtable Discussion on Welding and Cutting

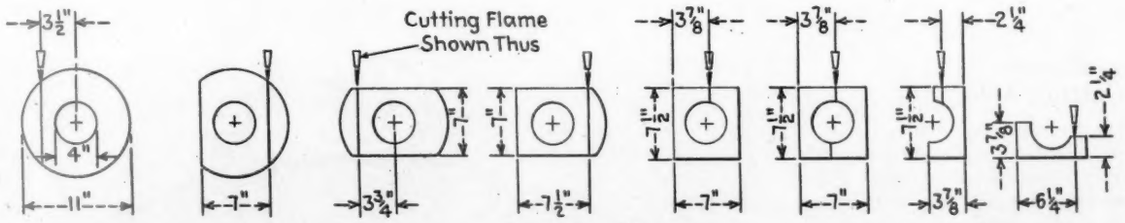
Question—What new applications of welding and cutting have you developed to meet the lack of materials and replacement parts? For instance, on driving boxes, crossheads, brackets and to replace various small forgings and castings?

Welding Proves Profitable

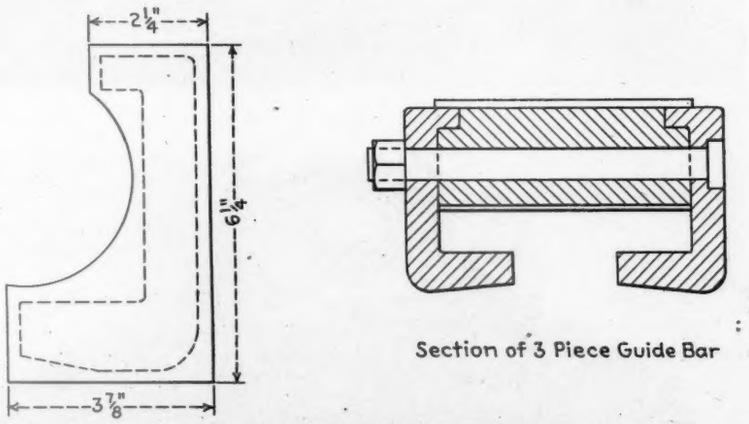
The wartime emergency has caused unusual demands for certain materials, making them critical items. In order to meet the need for replacement parts it has been necessary, due to lack of materials, to fabricate locomotive parts.

Brackets of all descriptions are now fabricated by cutting, bending, and fitting the necessary pieces of plate, which are then welded. Brackets thus fabricated invariably require less machining than the cast part and proper development of the fabricated part often results in greater strength and reduction in weight, as compared with the casting. Crosshead shoes are now fabricated from steel plate and welded construction; the weight is thus reduced to approximately one-quarter that of bronze shoes. The strength of the shoe has not been sacrificed and in the case of bronze shoes, a critical material has been released.

Fabricated parts in general have proved to be economical and practical to the extent that, in our opinion, many have taken the place of castings permanently.—*K. D. Read, Asst. Supt. Locomotive Shop, New York Central, Beech Grove, Ind.*



Sequence of operations in cutting an 11-in. diameter axle with a 4-in. bore to form the material from which the guide bar side plate is made



Left: Indicates how the finished plate is made.—Right: Cross-section of the three-piece guide bar assembly

Necessity is the Mother of Invention

Owing to the difficulty in securing materials and labor, I doubt whether any of us have been able to follow established practices in the repairing of locomotives and cars. I doubt, also, whether any of us want to go on record as to some of the practices we have been compelled to follow in order to keep our power on the road. On the other hand, many short cuts and new methods are here to stay, the same old story being still true that "Necessity is the mother of invention."

To save both labor and material, three-piece single guide bars are being made from old driving axles. The top or center section is forged from a 9½-in. axle and the sides are cut on an Oxweld cutting machine from hollow 11-in. axles. One axle makes two sides. The sketch shows the sequence of the different operations.

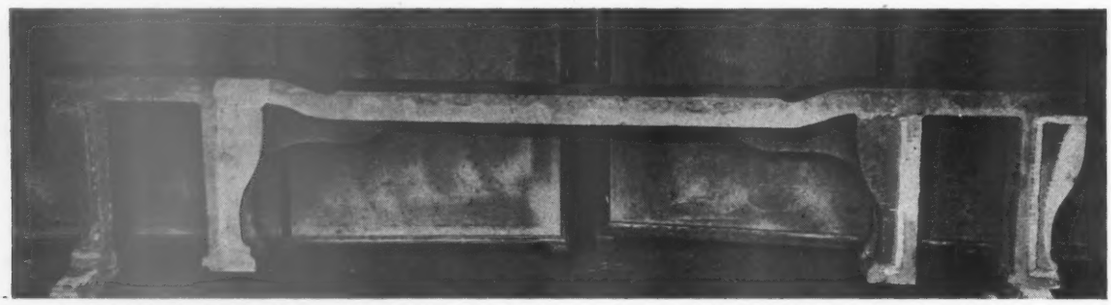
All railroads have more or less trouble with fixed rod bushings in side and main rods working loose in the rods, especially the cast iron and steel bushings. A good saving can be shown by metal-spraying a few thousandths of an inch on the outside of the bushing to get the required tonnage pressure. A good operator can do a job that does not require machining afterwards.

It is surprising how many parts can be fabricated with success from scrap materials, some of which will no doubt be continued after the emergency is over, such as the following: Smoke stacks out of boiler plate, valve bodies or spools out of boiler plate, pump and other brackets out of scrap material, and locomotive bells out of boiler plate.—*Shop Superintendent.*

Flame Cutting Extended

It has been our practice for some considerable time to flame cut bar stock or flame cut such items as brake beam hangers and

tender truck swing bolster hangers, and all other such parts as can be economically produced by the flame cutting process. We have found it necessary to considerably extend the flame cutting in certain parts as a substitute for castings, owing to the difficulty in obtaining castings of all kinds during the war. We do considerably more reclaiming of worn and broken parts by welding and bronzing, due to not being able to obtain any new material.—*A. H. Williams, General Supvr. Apprentice Training, Canadian National.*



Welded side frame for Woodard engine truck, C. M. St. P. & P.

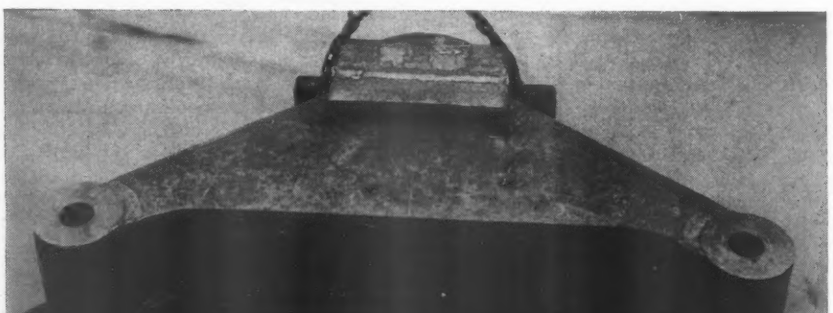
Welding-Minded; Flame Cutting Also

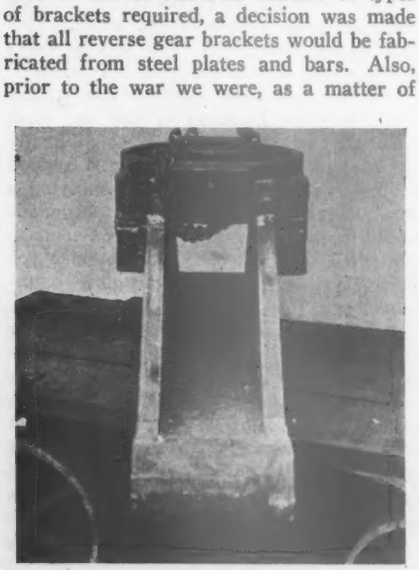
In the locomotive department, even prior to the war, we were distinctly welding-minded. For example, when the reverse gear order was put out we found ourselves with a considerable number of different classes of locomotives coming within the scope of the law requiring reverse gears. Under ordinary circumstances, brackets for such gears would be made of cast steel, but in view of the considerable number of types of brackets required, a decision was made that all reverse gear brackets would be fabricated from steel plates and bars. Also, prior to the war we were, as a matter of standard practice, manufacturing crank beds and upper crank cases for our Model 120 Winton gasoline engines.

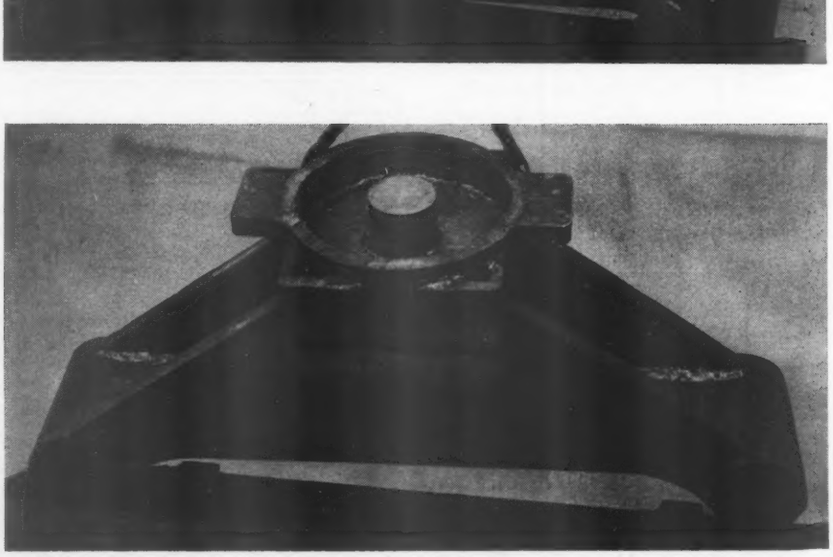
With this background, therefore, when the steel castings became critical, we had no hesitancy in substituting welded parts. The following are typical of some of these items: Air reservoir brackets, roller caps for Devoy trailer truck, guide yoke, reverse gear frame extension, coupler pocket for front end of steam locomotive, air pump bracket, frame filler brackets, bracket for bell stand, power reverse gear bracket, air reservoir bracket and bell crank for Baker valve gear. In the matter of substituting flame cut parts for forgings or castings, we now, as a matter of practice, cut the majority of our brake hangers, spring equalizers and the like direct from hot rolled plate of suitable composition. Such equalizers and hangers in some instances were formerly steel castings; in others, steel forgings. Flame cutting is used to a large extent in reducing machining required on almost all items of main and side rod and other motion work forgings. On one class of locomotives we were able to make a saving by cutting engine frames from rolled steel plate even though suitable patterns for cast steel were available. Frame sections for repairs are now all flame cut from plates. At the present time the use of cast steel locomotive frame binders has virtually been abandoned and these are all cut direct from suitable billets.

While not at liberty to disclose the details, nevertheless, as a part of our war effort we fabricated a large machine part by welding, which was formerly a casting, the rough weight of which was 29,000 lb., with entirely satisfactory results.

I might say that we have found very few







Three views of welded swing bolster for electric locomotive engine truck, C. M. St. P. & P.

items normally made in cast steel which could not be suitably reproduced by welding.—*K. F. Nystrom, Mech. Asst. to Chief Operating Officer, Chicago, Milwaukee, St. Paul & Pacific.*

Welding Locomotive Cylinders

Due to the inability of manufacturers to supply us with new main cylinders, it has been necessary to develop a procedure in welding where cylinders have dangerous fractures. After several methods had been tried we decided on the gas welding with the use of bronze welding rod. All of our cylinders are either cast grey iron or Ni-iron. Our method has proved equally successful on either, and to date we have welded main cylinders that in ordinary times we would have relegated to the scrap pile. Our procedure is as follows:

1—Sand blast the entire outside of the cylinder and determine if there are additional fractures that escaped attention.

2—Vee out all fractures, keeping the V about ¼ in. wide at the bottom and 1 in. to 1¼ in. at the top.

3—Place the cylinder in an oven and preheat with charcoal as fuel, for a period of about eight hours, to a temperature of 400 to 500 deg. F. This is usually done at night, so that we may start on the weld in the morning.

4—Once the weld is started we never stop until it is completed. We use from two to four welders, depending on the size of the weld, with the idea that the welder should not weld over 15 minutes at one time and have sufficient rest between welds, so that there will be no nervous tension if the job should take 12 to 15 hours.

Our oven is constructed as follows: The base is of circular construction, 7½ ft. in diameter, with a ½-in. by 4-in. iron band filled with firebrick, laid on the flat side and supported on suitable concrete base. Old rails are used as a support for the material to be welded, and also to anchor rollers on which the oven sets. The oven is constructed in cylindrical shape, 7 ft. in diameter, and 8 ft. high, of 3/16-in. scrap plates. Doors are cut in several places through which to weld, and are swung on hinges and latched. Two short pieces of tubing are welded to the sides of the oven opposite each other, so that a four-foot length of pipe can be inserted to turn the oven. This makes it possible to turn the doors to the weld and eliminate the uncovering of the material to be welded, thereby decreasing the danger of chilling. The top of oven is removable, as in some cases where welding is done toward the center of the material the heat will be unbearable and the top must be removed. The material is then covered to the fullest extent with sheet asbestos and the weld is made, replacing the top as soon as possible.

No. 3101 or 3500 welding rod is used with an adequate amount of flux. All welds are made in vertical position, if possible. There are several small openings in the sides of the oven, through which we can place a hand pyrometer to ascertain the temperature.

We have sometimes found it necessary, in cases where channels are fractured, to remove a piece from the saddle to reach the fracture which is welded on the inside of the channel; the piece is replaced in the saddle and welded in place.

After all the welds are completed the oven is closed and brought to a temperature of 500 deg. F. and allowed to cool down without further attention. This usually requires 48 hours, after which the cylinder is removed, the excess welding material machined off and the cylinder replaced on the locomotive. Seldom is any warping noticed.—*George E. Bennett, Shop Superintendent, C. & E. I., Danville, Ill.*

Roundtable Discussion on Training Methods

Question—Have you employed special training methods for supervisors and mechanics? What results have you obtained from these wartime measures? What features of this training do you think are suitable for your post-war training program?

T. W. I. Courses Beneficial

About one year ago the War Manpower Commission established a branch in San Francisco to conduct classes in "Training Within Industry." Since that time 285 of our shop supervisors have taken a course entitled "Job Instruction Training," and 47 have taken a course in "Job Methods Training." These courses consist of a ten-hour program spread over five days, two hours each day. We have found them very beneficial.—*B. M. Brown, General Superintendent Motive Power, Southern Pacific.*

Special Training For the Supervisors

The present critical situation brought about by the unusual work load, incident to the present high traffic volume being handled by the railroads, has clearly shown the need for the use of some improved special training methods designed to better fit the present and prospective supervisors to handle effectively the problems pertinent to that situation.

To better judge the special training necessary, some study of the needs therefore is paramount. Those needs are known to arise primarily through the following:—

1—Shortage of help.

2—The necessity to train quickly new or unskilled men to fill positions requiring skill beyond their past experience.

3—The need to understand how quickly to adjust daily routine to compensate for abnormal absenteeism.

4—How to handle and maintain discipline among female employees.

5—How to minimize unrest which is permeating all the railroad organizations due to dissatisfaction with the present wage schedules.

6—How to obtain greater effectiveness of production from the available help in order to offset the present shortage, and at the same time raise production to meet the demand for increased output of railroad equipment.

The achievement of this special training has been attempted through three general classes of instruction:

1—Those sponsored by government agencies, including Job Instruction Training, Job Relations Training, and Job Methods Training.

2—Foremanship conferences, sponsored by management, but based on courses offered by national training institutes, and

3—Foremanship conferences sponsored by state universities.

All of these methods have been found to be of value and each to have its merits and its limitations.

Experience has shown that the success of any one of the methods depends largely upon the following factors:

1—The interest and enthusiasm displayed by management's general supervisors in the welfare of their subordinate supervisors and the support given to them during their training period, together with proper recognition of the activity and progress shown by those receiving the training.

2—The selection of well qualified leaders to carry on this instruction.

3—The proper training of these leaders before they are allowed to undertake the promulgation of the instruction.

4—Careful selection of the subject matter and the method used in its presentation to the trainees.

Some of the pitfalls found to have been responsible, to a large extent, for the failure of the trainees to get the most out of the special instruction are:

1—Any attempt to coerce supervisors into taking part in these instructions and conferences instead of presenting the matter to them in such a way that their participation is voluntary and enthusiastic.

2—Careless selection of instructors and conference leaders.

3—The use of subject matter and job illustrations not particularly adapted to the industry in which these trainees are employed. Definitely, lack of interest and enthusiasm can be expected if the problems, the jobs and the methods used for illus-

trative purposes are not a part of the every-day work-life of the trainees. The railroad supervisor or prospective supervisor cannot be expected to maintain an interest and enthusiasm during a discussion on some problem or job which may be of vital interest to, say, the automotive industry, but which has no definite application in his shop.

4—The teaching of one thing in the conferences and continued practice of another in the actual operation of the shop quickly breaks down any good obtained through the conferences.

5—The failure on the part of management to take proper recognition of and action concerning constructive suggestions procured through the conferences.

Hundreds of mechanical department supervisors and prospective supervisors have now completed training courses, some of which have been highly successful, and many of which cannot be so classed. The need for continuation of special training is as great, or greater, than was the need for its original institution.

It is time to take stock of the situation and revise these programs so as to exclude the bad, include the known good features, inject such new material as a change in the national picture may require, and then make available to those who have not yet had the opportunity, instruction which they are, as a whole, anxious to obtain.

From the experience gained during this emergency it is probable that a training system which is made from the cream of all the present experimental systems will be of continual value to the railroad mechanical departments after the present emergency is over.—*F. K. Mitchell, Asst. G. S. M. P. & R. S., New York Central.*

Testing Training Methods During the War Emergency

We have been very much concerned with the methods used in the training of both supervisors and mechanics, and have resorted to the following procedures in an attempt adequately to train our personnel.

Training of Supervisors

At the present time we have a number of new supervisors on our railway. They are good mechanics and know their work, but some of them are weak in handling men; they lack the ability to teach other employees to do the job quickly, and some of them are lacking in the ability to handle grievances properly. To correct these deficiencies, we have tried the following:

1—We sent our master mechanics and shop superintendent a weekly letter, published by a reputable company, on management information. The master mechanics and shop superintendent were to use this as a basis of discussion in their staff meetings. It was thought they might be able to glean from this weekly letter some good ideas and policies to be used in directing subordinate supervisors. This method was tried for sometime, but was abandoned as we did not think we were justified in continuing this service.

2—We next tried a series of manuals on foremanship training. The supervisors were asked to study the manuals and then a discussion was held once a week in connection with other matters. This method was unsatisfactory because the supervisors were, in a large number of instances, too busy or too tired to study the manuals; and the text matter in these various manuals was largely a reiteration of what the supervisors already knew. Since we did not consider that we were gaining anything from the study of these manuals, the discussions were discontinued.

3—At one of our larger shops we recently tried the "Training Within Industry" program as put on by the War Manpower Commission. We selected three of our key supervisors and they attended lectures given by the assistant district representative of the War Manpower Commission for a period of one week. The supervisors who attended this conference felt that the training which they received was beneficial and worthwhile, and we decided to extend it to all of the supervisors in this particular shop. So far we have not definitely determined the value of this "Training Within Industry" program.

4—Another method used in training supervisors is by making use of Voca-films on subjects relating to safety, maintenance problems, and labor relations. These films are scheduled for showing at various shops at a definite time, and all supervisors are notified. We have our assistant superintendent motive power-personnel make a short talk before showing the films. This method has been particularly effective, and has a more lasting impression upon the supervisors than the lectures and discussions we have had heretofore. The fact that our assistant superintendent motive power-personnel takes these pictures around to the various shops creates the desired impression of their importance. We think this method of training supervisors will be useful in post-war programs.

Training of Mechanics

The regular apprenticeship training system is of long standing, and is covered by rules with the shop craft labor organizations. We have two forms of apprenticeship training—regular apprenticeship, and helper apprenticeship.

Regular apprentices serve four years, and are selected from young men between the ages of 16 and 21. Our requirements are that they must be high school graduates. We have, however, in some cases hired sons of employees as regular apprentices who have not completed their high school education. Approximately 50 per cent of our regular apprentices are the sons of employees.

Helper apprentices are selected from helpers who have served not less than two years as helper. Helper apprentices serve three years, and are given the same general training as regular apprentices.

Heavy inroads have been made on our apprentices by the Selective Service Act, and we are no longer training young men as regular apprentices. We are now appointing our mechanics from helper apprentices and from qualified helpers who have served four years or more as helper. We are also upgrading qualified regular apprentices to mechanics after they have completed two years or more on their apprenticeship.

Our practice, which is of long standing, is to promote laborers to helpers. We are now conducting a shop training school as a wartime necessity and in order to better qualify men to perform railway shop work. The trainees of this school are laborers employed in our shops and non-employees who desire employment in our shops. The non-employees attending this school get the same instruction as employees. This school is conducted three times a week, at night. One of the requirements for the non-employee trainees is that they be not immediately subject to the draft. The purpose of this school is to instruct trainees in the fundamentals of shop work, to stimulate their thinking, and by means of lectures, increase their general knowledge.—*G. S. M. P.*

On the Pittsburgh & Lake Erie

We have had some experience with the government subsidized job instruction training and job method training of our supervisors at McKees Rocks. A number of the supervisors completed these courses and have certificates of graduation. It is obvious that the men who received this training gained some personal benefit from it.

The difficulty lies in the practical use of this knowledge for the purpose of training new and inexperienced men. The Pittsburgh & Lake Erie has agreements with the shop crafts providing for a stipulated number of apprentices to be graduated, also a stipulated apprentice schedule—both helper and regular—in order to assure them an all-around knowledge of the trade by the time they graduate. This system has been in effect for years and every foreman whom these apprentices contact during their apprenticeship has been their instructor for the respective time allotted to each department. We consider that this system has been very successful, and will continue to be successful as long as we are mutually subscribing to the kind of labor agreement mentioned. We also, at times, assign a special apprentice instructor, who assists the apprentices when needed.

This method is recommended for the future, also for the post-war reconstruction period. Regardless of the working conditions mentioned, we do not wish to minimize the importance of having supervisors trained along some approved standard lines with reference to their contacts with apprentices, as well as other employees under their jurisdiction. It seems important that such standard methods and instructions should in all cases be given by highly experienced men who themselves have a considerable amount of familiarity and experience along the lines of work on which they are giving instructions.

With reference to new employees, such as laborers, helpers and mechanics, other than those who enter the rosters on completion of apprenticeships, we also call attention to the fact that shop craft agreements provide that the already established

employee may select or bid in his assignment, having preference over a newly hired employee. It is therefore impossible to know beforehand any details of the kind of work a new employee is to do, and it is necessary to give him the required instructions after he has been allocated to the particular job or place that he is permitted to take, after priority rights of older employees have been satisfied. These rights, granted by the agreement, are guarded very closely by the employees, and no deviation is generally found.

At the present time and for the immediate future, we will, no doubt, be compelled to train new employees in the above prescribed manner, male and female, in order to give them the necessary knowledge of the job after being placed in their respective positions.—*K. Berg, Supt. Motive Power, P. & L. E.*

Supervision Benefited

The State of Michigan assigned a group of instructors, available to all industries, to give a course of lectures and demonstrations, free of cost to the participants, this instruction program being termed "Training Within Industry." All of our local supervisors and some of the lead men were enrolled. Without going into details, it has proved to be of considerable value to them in the handling and training of men on new jobs. As one foreman remarked, "The way to find out how little you know about the details of some equipment is to try and explain it to someone else."—*Shop Superintendent.*

Special Training For Machine Operators

Toward the close of last year we were having considerable difficulty in keeping our machine tools continuously in operation, particularly in our large machine shops at Juniata, because of the number of men who were being furloughed for military duty, or who for other reasons were not continuously at work.

In order that we might meet the demands of the railroad for repair parts for locomotives and provide the necessary machined parts for new locomotives under construction, it became necessary to correct this situation. Accordingly, we arranged to set up a training program for machine operators on the various types of machine tools. The men selected for this training are given experience on a number of machine tools of the respective types, with machine operators selected on the basis of their ability to instruct new men. The training period covers a definitely specified time which, as above indicated, is allocated to selected machines and operators. For example, trainees for positions as engine lathe operators are given experience on five different size lathes during the training period.

The progress of these trainees is followed up by a supervisor who has been assigned to that particular duty and who reports currently on their progress.

This program has provided us with trained operators available for filling temporary vacancies which occur on account of sickness or for other reasons, and makes available men for permanent vacancies as they may occur. It has worked out very satisfactorily and has very much reduced the idle machine tool hours which were lost prior to its adoption. The trainees are paid on an hourly basis during the training period.

Our method for training supervisors has been in effect for many years and has proved entirely successful. It is our practice to develop from among our working forces, by constant observation, those who possess the necessary mechanical ability and supervisory qualifications to lead and direct the work of other employees. This method has been employed continually and up to the present time there has been no occasion to adopt new or different methods during the period of this emergency because of lack of trained persons among our working forces to promote to supervisory positions.—*F. G. Grimshaw, Works Manager, Pennsylvania, Altoona, Pa.*

Two Methods of Training Supervisors

It has been our privilege to enjoy the benefits derived from two special training methods for supervisors. The Job Instructor Training course offered by Training Within Industry, an agency of the War Manpower Commission, was first completed by our supervisors. This was a ten-hour course, divided into five two-hour sessions. This wartime measure proved successful in teaching supervisors how to break in new workers and instruct old workers how to do a job properly. A noticeable result from this training was the realization on the part of each supervisor that better results could be obtained more easily when instructing employees, by following the methods set up in the Job Instructor Training course. This training proved to be a revelation, as it demonstrated the inadequacy of our method of instruction to workers.

We are convinced that the application of this training by our supervisors in instructing their men how to do a job has paid dividends in conservation of manhours. Heretofore, an excessive number of hours was lost by both the supervisor and employee in learning the job; and a higher degree of efficiency has been obtained by the workmen. This has resulted in increased production and improvement in quality of workmanship.

All features of this training are applicable for our post-war training, as the principles are sound and will apply at all times.

Our supervisors have also had the privilege of attending a series of "roundtable" discussions conducted by the state director for Vocational Training for War Production Workers, under the title of "Foremen Improvement Conferences". This was a series of conferences held weekly at the shop. A choice of subject matter was offered, with a suggested list of topics deemed particularly adaptable to our railroad problems. These conferences were led by a duly accredited leader who was particularly qualified, being a student of trade and industrial education. All conferences were conducted on the plan of every member participation.

Such topics as safety first, teamwork and co-operation, introducing new employees to the organization, how to correct or reprimand workers, the foreman as a leader, and costs of locomotive repairs at shops as related to foremen and supervisors, were among those discussed, and much value was derived from the facts developed in these human relations and operating problem topics.

A definite plan was followed in conducting these conferences in order that worthwhile conclusions would be reached. It was customary to follow this outline: State topic, define its purpose, discuss topic, draw conclusion. Pertinent information brought out by the group was recorded and developed into a composite report at the conclusion of each conference, each member being provided with a copy for his personal file at the next meeting.

We are convinced that much value was gained from these conferences, as evidenced from the interest manifested, the after-meeting groups which voluntarily formed to continue discussion, and the active participation of every member. Direct application of the many suggestions brought out in these conferences has resulted in an increase in efficiency of effort, better control of waste and scrap, substantial reduction in operating costs and closer interdepartment co-operation.—*K. D. Read, Asst. Supt. Locomotive Shop, N. Y. C., Beach Grove, Ind.*

Visual Methods Coupled With Conference Discussions

The problem of setting up special training methods for supervisors and mechanics is of accepted importance in these days of scarcity of manpower.

Training programs that worked in normal times can only be successful today on an accelerated basis. The Railway Educational Bureau is applying the fundamentals of practical instruction which we have developed through the years to this problem. We are adapting visual training methods to our present programs. Sound slide films, 16 mm. motion sound and silent films are being used in conference discussions among supervisors to present visually a statement of certain specific problems.

A few of the problems so presented are: training understudies, statement of a supervisor's responsibilities and duties in wartime, specific training aids for machinists, welders, electricians, etc.

We are utilizing the conference and visual methods of training more and more daily, correspondingly diminishing the use of text material. Apprentice instructors representing seven major railroads agree that the results being obtained through the new training plan are very gratifying not only

with apprentices, but with mechanics and foremen. Frankly, this new method is merely the application of good selling and advertising tactics to a sound training program.—*R. C. Buell, The Railway Educational Bureau.*

Baltimore & Ohio Practices

The Baltimore & Ohio has three groups of apprentices—regular, helper and special. Regular and helper apprentices are instructed in all branches of the work of a particular craft. Special apprentices are instructed in all branches of the work handled in the maintenance of equipment department, and are required to have a technical educational background.

Those who are adept in the work which they are performing are considered for supervisory positions after they have completed their apprenticeship. It might be said, therefore, that supervisors are "hand picked."

We are continually urging all of our employees, both workmen and supervisors, to avail themselves of all means of securing additional knowledge that is available —by attendance at courses in schools and colleges conducted by the various states and municipalities, as well as those sponsored by the federal government. Any lectures that are called to our attention are given wide publicity. We also urge all to take advantage of the instructions through the various correspondence school courses, such as the International Correspondence School and others.

We have also instituted job instructor training sponsored by the War Manpower Commission. The course has not been extended to all supervisors through the system yet, but instruction is progressing. In view of the comparatively short time since it was started, we are not in a position to make a definite statement as to results that are obtainable.—*A. K. Galloway, General Supt. Motive Power and Equipment, B. & O.*

Roundtable Discussion on Diesel Maintenance

Question—What particular problems are giving you concern in the servicing and maintenance of Diesel locomotives? Have you found it necessary to provide special facilities and organization other than those required for steam locomotives? What?

Labor Problem Is Serious

There are still many perplexing problems to be solved in the operation and maintenance of Diesel power road locomotives. One of the most concern is the labor problem; it seems that the enginemen continuously want to do less work and demand more pay.

The maintenance problem has not been so acute in that practically all of our maintenance forces are willing to perform their duties to the best of their ability; but the trouble is again in the labor organization, because when a certain mechanic or an electrician with outstanding ability is in line for advancement, he cannot be assigned to the job for the reason that others who have greater seniority demand that they be given that place, even though it is known that they do not possess the desired qualifications Nevertheless, such men must be trained, or at least tried out for several months, regardless of the unsatisfactory service rendered. Of course, any outstanding employee can be promoted to supervisor or foreman, but it is just out of reason to employ all of them in such a capacity. Someone actually has to do the work in a careful and precise manner, which is not always done when forced to use men who are more or less indifferent to new ideas and standard practices.

Repairs and current maintenance of Diesel electric locomotives are entirely different from the work performed on a steam locomotive, in that the Diesel demands closer attention to its many moving and intricate parts, all of which must be accurately fitted and assembled to within at least .001 inch. Some parts, such as fuel injectors, etc., are finished with still greater precision, all of which demands the attention of specialized and highly skilled mechanics.

As time goes on and Diesel power begins to predominate on the railways, the special maintenance facilities will gradually be improved and perfected, all of which will be an incentive for the younger and mechanically-minded men to study and fit themselves for such work. Right now we have a special committee making surveys on other lines, with the intent and purpose of making recommendations for modern maintenance facilities, which we intend to establish as soon as the committee completes its assignment.—*E. F. Weber, General Supt. Automotive Equipment, Burlington Lines, Chicago.*

Suggestion on How to Minimize Dirt Nuisance

One of the most obstinate problems in connection with the maintenance of Diesel switching locomotives is that of keeping the working parts clean. Dirt is the root of all evil on a Diesel. This is true of the electrical equipment, as well as the mechanical. It would be no exaggeration to state that 50 per cent of the routine work on a monthly inspection consists of cleaning operations.

Diesel switchers usually work in a dirty industrial section of town. To the dirt from adjacent factories and steel mills is added the smoke and cinders from steam locomotives. The dirt is drawn into the engine compartment, after which it is blown down into the traction motors. The engine room is always under a partial vacuum and therefore tends to draw in any soot or sand in the air.

It is possible that this condition might be reversed. Instead of sucking the cooling air into the engine room it could be blown in. This would tend to keep the air in the engine compartment at slightly over atmospheric pressure, which would automatically prevent the infiltration of dust. There could be one large blower fan located at the front of the locomotive. This fan would receive its supply of air through filters and would deliver clean air to a pressure compartment. From the latter there should be suitable ducts leading to the traction motors, to the air compressor, to the engine room and possibly to the radiators also. By the introduction of nothing but clean filtered air to the various working parts, a material reduction in maintenance could be expected.—*J. E. Kloss, New York, Chicago & St. Louis, Buffalo, N. Y.*

Special Facilities Required

We have difficulty in securing men for servicing and maintaining Diesel locomotives who have sufficient training in both electrical and mechanical work to take care of both the Diesel engine and the electrical traction motors, generators, control equipment, batteries, etc. Especially where there are only a few locomotives at one station, it is desirable that the service men be qualified in both the electrical and mechanical work. At larger centers this can be taken care of in much the same manner as steam power; that is, electricians taking care of the electric work and machinists handling the mechanical maintenance.

We have found it necessary to have men with special training in Diesel electric work to supervise the operation and maintenance, and certain special facilities also have had to be installed. Tools specially designed to take care of the work on the pistons, cylinders, cylinder heads, fuel system, etc., have had to be provided and it has been found desirable to furnish lockers for the smaller tools, so that they are available to all concerned. Also, the cleaning filters on the lubricating oil systems and the apparatus used for filtering the air for the Diesel engine have required tanks and cleaning apparatus not commonly provided for the steam locomotive work. Where the number of locomotives in service warrants the use of apparatus for changing wheels, we have installed a drop table to permit quick change of wheels or traction motors.—*A. H. Williams, General Supvr. of Apprentice Training, Canadian National.*

Extensive Railroad Demand Developing For

New Shop Equipment

Having entered the war period with shop facilities from 25 to 40 years old the pressure of history-making traffic and high speeds are showing up the old tools

WHEN the United States entered World War I in 1917 the repair facilities of American railroads were in far better physical condition to take on the burden imposed by the peak loads of wartime transportation than they were when we entered World War II in 1941. A large part of the most important railroad repair shops, engine terminals and car repair shops were either built new or rebuilt and equipped with up-to-date machinery in the early years of this century. As a result, when war broke out in 1918 most of our more important railroad repair plants were relatively new and well equipped to do the job of that period. While no record is available of the average age of all machine tools in service at that time it is a reasonable assumption that it was not excessively high.

The purpose in making the above statements is to direct attention to the fact that the 10 years after the end of the last World War marked the end of a long period of repair shop construction and major installations of machinery and equipment. Since 1930 expenditures for new shop equipment have been sporadic and, except for one or two scattered instances, have been definitely limited in any one year to total amounts considerably below previous 10-year averages.

In 1934, during the regime of the Federal Co-Ordinator of Transportation, surveys were made to determine the possibilities of effecting economies by the replacement of obsolete machine-tool units with modern machines. In the course of these investigations it was found that in the typical locomotive repair shop of that period the average age of all machine tools was 20 years and that in 75 per cent of the machining operations performed in the course of locomotive and car-repair work the replacement of 20-year-old machines with the new tools of that period would effect savings, in many instances, of as much as 80 per cent of the cost of doing a specific job.

Nine years have gone by since those studies were made and while there have been several instances of major replacement programs the volume of such installations has not been great enough to stabilize the average age of tools in most of our shops. Result: in 1941 the roads faced the greatest traffic in all of their history with a shop machinery inventory, in most cases, considerably in excess of a 25-year average age. It is no wonder, then, that in the 22 months since we entered the war those who are charged with the responsibility of operating our repair shops and engine terminals have become more and more conscious of the inability of 25- to 40-year-old machine tools to hold up their end in a production battle such as present-day traffic imposes on those shops. It is surprising how many of the machine-tool units installed in shops built between 1900 and 1915 are still the mainstay machining units in the plant.

In those instances where specialized departments were completely modernized with new machinery and where new units have been installed in departmental groups the value of the new machines and the handicaps of the old machines have been especially marked. There are numerous instances where units and groups of new machines have paid for themselves in five years or less and when they were purchased there was no expectation that they could be amortized in even two or three times that period of years.

When a situation in which the demand for machine tools for equipping defense plants practically made it impossible for the railroads to secure new equipment was immediately succeeded by the establishment of the priority system that added to the difficulties many mechanical men began to realize that possibly the intention to replace obsolete tools with new ones had been postponed somewhat beyond the point of safety. Only by the exercise of latent ingenuity and the most intensive utilization of shop equipment were many roads able to keep up with the ever-increasing demand for motive power and car equipment. It is not surprising, therefore, that many shop men who may have previously been somewhat indifferent to the value of new equipment should develop an interest in the acquisition of new facilities such as has not existed for some years. In all fairness it should be admitted that not until the past two years have shop operations been at a sufficiently high load rate to show up the major shortcomings of old machinery and the obvious advantages of modern machinery. In any event, wartime traffic has created a vast demand for new railroad shop equipment and there is now no longer any doubt that this demand must be supplied if the standard of wartime transportation service is to be maintained.

Results of a Broad Survey

Early in this year two things became evident: that the railroads must have new shop equipment if they were to keep motive power and cars in first class serviceable condition; that the needs of defense industries, passing as they were from the construction to the production stage, were lightening the demand for machine tools sufficiently to make it easier for other industries, particularly the railroads, to obtain badly needed units.

With the idea of finding out exactly the nature of these needs the *Railway Mechanical Engineer* made a study of conditions and requested brief and specific information from 43 of the most important Class I roads, 39 of which co-operated by making known their requirements for shop machinery. These railroads represented 71 per cent of the route mileage, 80 per cent of the steam

locomotives, 74 per cent of the Diesel-electric locomotives, 97 per cent of the electric locomotives and 74 per cent of the freight cars.

In approaching a study of this kind it was our desire to find out as much about the underlying reasons back of the demand for new equipment in car and locomotive shops as it was to determine the character of the equipment required. This for the reason that there have been an increasing number of indications over a period of several months that our railway repair plants are destined to become a factor of first importance in the continuing ability of the railroads to carry the wartime load, and that the capacity of these shops to do this job is now reaching a stage where machines may be more important than manpower. Such a statement may seem like a contradiction except for the explanation that when the supply of manpower is static or diminishing and hours of work have reached their practical maximum the remaining solution to increased output is new facilities of greater productive capacity.

This assumption is definitely borne out in the replies that were received to the question, "For what reason are these machine tools needed?" The greatest number of roads, 28 out of the total, gave the necessity for increased output a place of prime importance while close behind this reason, in importance, was that of the need for greater accuracy in machining operations. This reason was given by 26 roads. Relief for an increasing manpower shortage was the reason why 21 roads needed new equipment and 16 of the 39 roads gave the desire to decrease the cost of machining as a reason. It seems superfluous to add that the replacement of obsolete machine tools with modern equipment will accomplish all of these objectives simultaneously.

We have had a suspicion for some time that extended periods of high-speed and heavy-tonnage operation of both freight and passenger trains would have a definite effect on specific shop operations. For that reason we asked these roads to tell us what shop departments were most in need of new tools and the replies on this basis were:

Car wheel shop	24 roads
Turret lathe department	20 roads
Driving wheel work	19 roads
Rods and rod bushings	16 roads
Piston and crosshead work	13 roads
Driving box departments	12 roads

There is significance in the fact that wheel work is right up at the top of this list and bears out many observations that wheel shops are having more and more difficulty in keeping up with their output schedules because of the inability of old machine tools to turn out accurate work in large quantities. It is ironical that modern locomotives and cars, operated at high speeds, should demand infinitely higher standards of accuracy in wheel, axle and bearing machining from shop equipment of a character and condition least able to furnish it. The mounting tempo of the demand for new wheel shop machinery is not, therefore, in the least surprising when these conditions are taken into consideration.

What Type of Machines Are Needed

An analysis of the types of machines needed reflects a growing need for new engine lathes, turret lathes, vertical turret lathes and boring mills, vertical and radial drills, grinders, milling machines, shapers and horizontal boring machines. The scope of the demand and some indication of relative importance of demand can be seen in the accompanying tabulation of the number of roads, out of a total of 39 reporting, asking for machines of the specific types listed.

Demand for Specific Types of Machines

Engine lathes	27 roads
Turret lathes	20 roads
Drilling machinery	21 roads
Vertical boring and turning machines	21 roads
Grinding machines	21 roads
Milling machines	18 roads
Shapers	12 roads
Horizontal boring and milling machines	10 roads

It is rather difficult to draw specific conclusions from an analysis of types of machines required but there is one that seems reasonably safe from contradiction. For years, one of the major obstacles to the installation of new machines, particularly those of the more expensive variety, has been the lack of volume in machine work from the standpoint of the number of parts required. Lack of volume has operated to forestall opportunities for maximum economies in machining. Wartime traffic has provided volume in locomotive parts production far beyond anything previously experienced. Those roads with new machines have watched with amazement the ability of these modern machines to take on a seemingly limitless burden of new work and do it in a manner and at a cost that establishes a violent contrast to the mediocre ability of the 25- or 30-year-old machine. Here, before the eyes of every shop supervisor, is eloquent proof of what the production industries have known for years. While the picture of modern machine-tool efficiency is fresh in the minds of railroad shop men there should be established the means of making it necessary for every old machine tool either to justify its existence or be thrown on the scrap heap.

The concluding part of our survey was the question "When are these machines needed—now or in the post-war period?" All but four roads stated emphatically that the need is *right now*. Some roads reported that they had programs for the replacement of shop equipment in the post-war period in addition to their needs at the present time.

Six Committees Present

Electrical Section Reports

The work of the technical committees has continued the important functions of the organization although no general meetings have been held in 1943

THE Electrical Section, Engineering Division, Association of American Railroads, has received five technical reports in addition to the report of the Committee of Direction. In lieu of an annual meeting of the Section in October, 1942, the Committee of Direction held a meeting in New York on November 18, 1942, for the purpose of reviewing the reports of the committees. No meetings except those of members of individual committees have been held this year. Two items have been approved and published in the 1943 Supplement to the Manual. These are: (1) Form of Agreement for Purchase of Electrical Energy for Other than Traction Purposes, and (2), Specifications for Rubber Insulated Wires and Cables No. 18 AWG and larger. A committee of four to represent the Section on war emergency activities has been functioning during the past year.

The Electrical Section was represented by one of the members of the Committee of Direction on the Special Committee on Blackout of Railway Equipment. The conclusions reached as the result of the tests made have been embodied in a report that has been filed with the authorities concerned.

An appropriation of $2,000, authorized by the Association for use in 1943, has enabled the research staff of the Engineering Division to make commendable progress in an investigation of electrolytic corrosion of steel in concrete. An additional allotment of $1,000 has been endorsed for use in 1944. The report of the Committee of Direction is signed by D. B. Thompson, N. Y. C., chairman of the Electrical Section.

Electrolysis

The work done by the Committee on Electrolysis during the past year has consisted of (1) establishment of a special test to determine resistance to ground, amount of current flow, and corrosion of steel embedded in different thicknesses and kinds of concrete under controlled conditions in the field; and (2) the study of a catenary pedestal at Collinwood, Ohio, on the New York Central, which in the past has shown an excessively large current flow.

For the purpose of the first test, six-inch concrete cubes containing various mixes of concrete with and without additional admixtures to increase electrical resistance were made up, measured dry, and after various periods of immersion, contacts to the blocks were made by coating two opposite faces with sprayed copper. In the comparisons, cubes made of concrete containing an admixture known as Morene showed the highest relative resistance. The other admixtures did not seem to increase the resistance appreciably relative to that of concrete containing no admixture.

Following the laboratory tests with the cubes, field specimens have been made up consisting of cylinders having outsider diameters of 5 in. and 13 in., respectively, and containing at the center a 6 ft. section of 1 in. diameter steel rod. These test specimens consist of one each of the following three admixtures: Morene, celite, and hydrated lime. These units will be placed in the ground and subjected to an electrical potential over a considerable period of time. Measurements will be made periodically of the current flow and potential; and at the end of the test, the steel rods will be removed from the concrete and the corrosion loss determined.

The catenary footing tested at Collinwood, Ohio, consisted of a concrete base with four anchor bolts on which it was found there was an occasional current flow of as much as 150 amp. between the catenary supporting structure and the ground. By jacking up the supporting structure, insulating it from the footing, insulating each anchor bolt separately, and insulating guy wires, it was possible to determine the course of the leakage current. This was done by placing batteries and an ammeter between the anchor bolts and ground. The negative side of the batteries was connected to the structure and the positive to the anchor bolt.

It was found that one anchor bolt had a resistance to ground much lower than the others and it is believed that the low resistance resulted from ground water coming in contact with either the anchor bolt or reinforcing steel in the footing. The report also states it seems probable that flaws in the concrete footing may have been a primary factor.

The report is signed by A. E. Archambault (chairman), N. Y. C.; R. Beeuwkes, C. M. St. P. & P.; D. P. Dickie, Western Union Telegraph Company; Paul Lebenbaum, So. Pac.; P. L. Mathewson, Can. Nat'l.; W. P. Monroe, consulting engineer; G. K. Shands, Virginian; J. S. Thorp, D. L. & W.; H. P. Wright (vice-chairman) B. & O.; J. M. Trissal, Ill. Cent., and S. M. Viele, Pennsylvania.

Transmission Line And Catenary Construction

Committee No. 3 on Overhead Transmission Line and Catenary Construction has participated with authorized representation of the Edison Electric Institute in the preparation of Specifications for Electrical Supply Lines at Crossings with the Facilities of Steam and Electrified Railways. Pending a final agreement between the two groups concerned, emergency specifications for crossings have been established. These are as follows: Electric light, power supply and trolley lines crossing over or under the tracks and facilities of railroads shall conform, in general, to the requirements as set forth in

Part 2 of the Fifth Edition of the National Electrical Safety Code, issued September 23, 1941.* However, where the crossing is of sufficient importance to require greater strength of supporting structures than specified therein, the transverse strength shall be approximately 50 per cent greater than specified in the case of wood poles, and approximately 30 per cent greater than specified in the case of steel towers. Railroads shall cooperate with power companies to keep them advised as to the types of crossings which are considered as requiring this additional protection.

In states where the above conflicts with regulations issued by duly authorized authority, such regulations will govern.

The report is signed by K. H. Gordon (chairman), Pennsylvania; H. F. Brown, N. Y. N. H. & H.; P. B. Burley, Ill. Cent.; P. M. Fey, B. & O.; S. W. Law, No. Pac.; John Leisenring, Ill. Cent.; R. A. Mylius, Virginian; S. R. Negley, Reading; J. S. Thorp (vice-chairman), D. L. & W.; S. E. Noble, C. & N. W., and P. E. Snead, Southern.

Electric Heating and Welding

The report of Committee 5 on Electric Heating and Welding is concerned entirely with safety precautions to be followed in electric welding. Major items covered in the report are as follows: While voltage across the arc may range from 20 to 140 volts, on open circuit it may vary from 60 to 120 volts. This comes within a range that should be handled carefully. Even greater care should be exercised on the higher supply voltages.

From a safety standpoint, machines should be selected for (1) quality of workmanship and insulation; (2) shielding of electrical connections and windings from moisture; and (3) guarding of energized parts from human contact.

Periodic inspections should be made to determine any exposed or energized parts; to measure open-circuit voltage; to record machine insulation resistance; to test for voltage between primary and secondary windings of transformers to see that voltage does not feed back through the secondary to an unused transformer when such devices are connected in parallel; to watch for glow in the tubes rectifiers under "no-load conditions"; to make regular inspections and insulation tests of cables, plugs, receptacles and feeder lines. Attention is also called to the use of a ground circuit through the plug, receptacle, conduit and conduit ground. Periodic tests of the ohmic values of such circuits should be made.

Attention is called to the importance of a well insulated electrode holder, the use of suitable gloves and when necessary the insulation of the operator from ground by dry boards or insulating blankets. Insulated electrode containers are also recommended which enable the operator to clamp the new electrode into the holder without grasping it in his nongloved hand. Goggles and helmets without light leaks must be used and the shades of filter glasses, tentatively standardized by the American Standards Association, suitable for electric welding are listed in the table.

Other persons working in the vicinity of welders must be protected by adequate shields or should also wear goggles for protection. Warning signs and roped-off and barricaded areas are also recommended.

Shade No. 5—Light electric spot welding.
Shade No. 6—Arc welding up to 30 amp.
Shade No. 8—Arc welding and cutting exceeding 30, but not exceeding 75 amp.
Shade No. 10—Arc welding and cutting exceeding 75, but not exceeding 200 amp.
Shade No. 12—Arc welding and cutting exceeding 200, but not exceeding 400 amp.
Shade No. 14—Arc welding and cutting exceeding 400 amp.

Burns may be caused by direct contact with live parts, by molten metal, or by radiant energy from the welding arc. Means of protection include suitable clothing in addition to the usual accessories such as goggles, hand shields, helmet shields, etc. Screens and walls should be protected by paint which does not reflect ultra-violet light. First-aid equipment should be available for treatment of burns and the personnel should have instructions in its use.

Welding operations conducted out-of-doors ordinarily require no special precautions to protect against gases, fumes and smoke. In enclosed areas excessive fume concentration may necessitate the use of special ventilation or respirators.

Fire hazards include the welder's clothing and nearby flammable objects. The report states that welding and cutting operations must not be permitted in or near rooms containing flammable vapors or liquids and that the welders and their helpers should be constantly alert to detect and promptly extinguish any fire. Caution is also recommended to avoid welding or cutting on closed vessels in which internal pressure may be caused by the heat of the welding.

The report is signed by C. A. Williamson (chairman), Texas & New Orleans; L. S. Billau, B. & O.; S. J. Fairbanks, Waterloo, Cedar Falls & Northern; H. E. Gannett, C. & N. W.; J. E. Hawe, Gr. Nor.; C. P. Kahler, U. P.; F. A. Linn, Ill. Cent.; R. P. Winton (vice-chairman), N. & W.; J. C. McElree, Mo. Pac., and G. K. Shands, Virginian.

Track and Third-Rail Bonds

At a meeting held on November 18, 1942, the Committee of Direction authorized the submission of specifications for welded bonds, for letter-ballot approval on condition that Committee 9 accept certain suggested revisions. However, because of questions that arose within the committee in the study of these revisions, which led to proposals for still other modifications, it was deemed best to withhold the specifications from the letter-ballot and present them to the Section again as revised. Accordingly, the specifications are submitted in the 1943 report for adoption and publication in the Manual.

The types of bonds included in the specifications are welded rail-head U-bonds and extended bonds. The specifications cover: Purpose; Drawings; Tender; Alternates; Material and Workmanship, Design; Conductors; Terminals; Identification; Resistance of Installed Bonds; Purchaser's Order Requirements; Inspection; Tests; Marking; and Warranty.

The report is signed by Paul Lebenbaum (chairman), So. Pac.; B. E. Arias, Nat'l Rys. of Mexico; W. P. Bovard, Ohio Brass Company; H. F. Brown, N. Y. N. H. & H.; J. H. Davis, B. & O. (retired); H. H. Febrey, American Steel & Wire Company; C. G. Lovell, C. M. St. P. & P.; H. G. McMillan, N. Y. C.; J. S. Thorp (vice-chairman), D. L. & W.; R. A. Mylius, Virginian;

* Issued as National Bureau of Standards Handbook H 32, Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines, comprising Part 2 and the Grounding Rules of the Fifth Edition, National Electrical Safety Code. Copies may be obtained from the Superintendent of Documents, Washington, D. C. Price 65 cents.

S. R. Negley, Reading; C. R. Wadham, Ill. Cent., and L. C. Walters, Southern.

Illumination

The report of Committee 10 on Illumination, which is a very brief report, reads as follows: A considerable amount of information has been assembled on the subject of fluorescent lighting, application, economic value, etc., but due to drastic restrictions on material of this kind, it is the opinion of this committee that publication of an extended dissertation at this time would be of academic value only. The period covering the remainder of the restrictive period will undoubtedly see further developments which would make obsolete a part of the information now in hand; hence it is thought to be advisable to withhold a report thereon until a more active interest will be served.

Discussion of the subject of the control of lights at outlying points, where no regular attendant is available, brought out the suggestion that a switch be provided at an accessible point and that local air-raid wardens be authorized to operate the switch as required. This appears to be the simplest solution involving the least use of critical materials. Where no regular railroad attendant or air-raid warden is available, it will be necessary to resort to individual study and treatment.

The report is signed by E. R. Ale (chairman), Pennsylvania; D. M. Burckett, B. & M.; H. F. Finnemore, Can. Nat'l Rys.; W. F. Freutel, C. & O.; J. E. Gardner, C. B. & Q.; H. A. Hudson, Southern; G. T. Johnson, N. Y. N. H. & H.; S. D. Kutner, N. Y. C.; L. S. Billau (vice-chairman), B. & O.; R. A. Mylius, Virginian; Frank Ross, Terminal R. R. Assn.; G. L. Sealey, Reading, and C. P. Trueax, Ill. Cent.

Cab Signal Tests Made on the Turntable

The usual arrangement for making cab signal tests on locomotives entering or leaving the enginehouse is to have the approach tracks equipped with insulated track sections to which the necessary track currents can be applied. The locomotive must stop at these positions and in some locations it is necessary to have as many as seven tracks equipped.

The Chicago, Rock Island & Pacific has greatly simplified the usual arrangement by making the tests on the turntable. Insulated cables carrying the test circuits are run along the web of each rail on the turntable and these are supplied consecutively with the four types of impulses by means of a sequence timer.

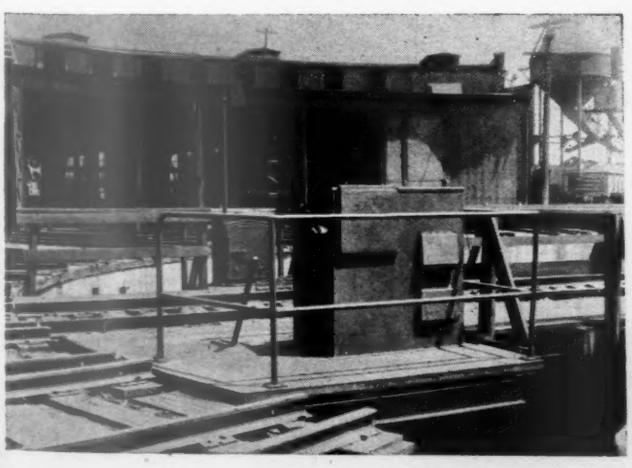


Fig. 1—The doorknob switch for starting the cab signal test is mounted at the left on the turntable control cabinet—One of the signal positions may be seen on the opposite side of the turntable

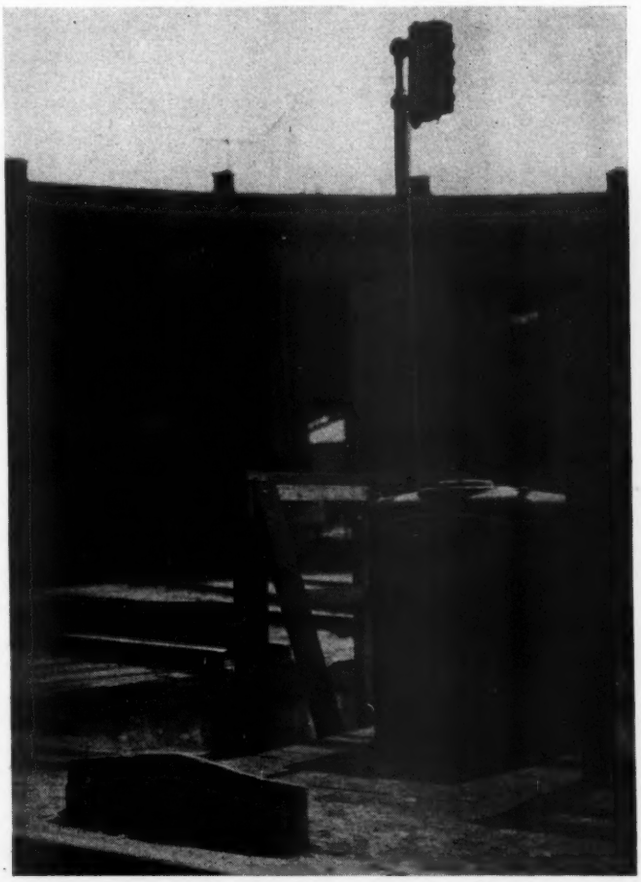


Fig. 2—One of the signal positions with the control equipment housed in a discarded wayside signal case mounted at one end of the turntable

After the locomotive is run onto the cable, the turntable operator turns the small knob shown on the left side of the turntable controller in Fig. 1. This starts the sequence timer which in turn supplies the four signals, one after the other, to the track circuit. At each end of the turntable there is a cab signal indicator which produces signals corresponding to the impulses in the track circuit. The man in the locomotive checks to see that the signals received in the locomotive correspond to those shown at the ends of the turntable.

The test may be made while the turntable is in operation and usually requires less time than it takes to move the table. The locomotive is stopped only once and only one test location is required.

It will be noted from the illustrations that old signal cases are used to house the control apparatus. These are weather-proof and the railroad has found a variety of uses for them in the operation of pumps and other control equipment which must be placed out-of-doors.

The ramp shown in the foreground in Fig. 2 is used for checking the automatic train control equipment which is being replaced by the new four-indication cab signal system, for operation with the C. T. C. system on the main line between Blue Island and Rock Island, Ill.

Enginehouse Heating

How can a group of unit heaters be controlled to meet the requirements of heating an enginehouse?

Can you answer the following question? Suitable answers will be considered as contributions and will be published in a subsequent issue. If you have questions to ask, send them in also. Answers and questions should be addressed: Electrical Editor, *Railway Mechanical Engineer*, 30 Church Street, New York.

There is always the danger that a locomotive may be moved onto or off a turntable when the rails are not properly lined up. Can you suggest a system of signals or other means which will tell the hostler when the tracks are properly aligned?

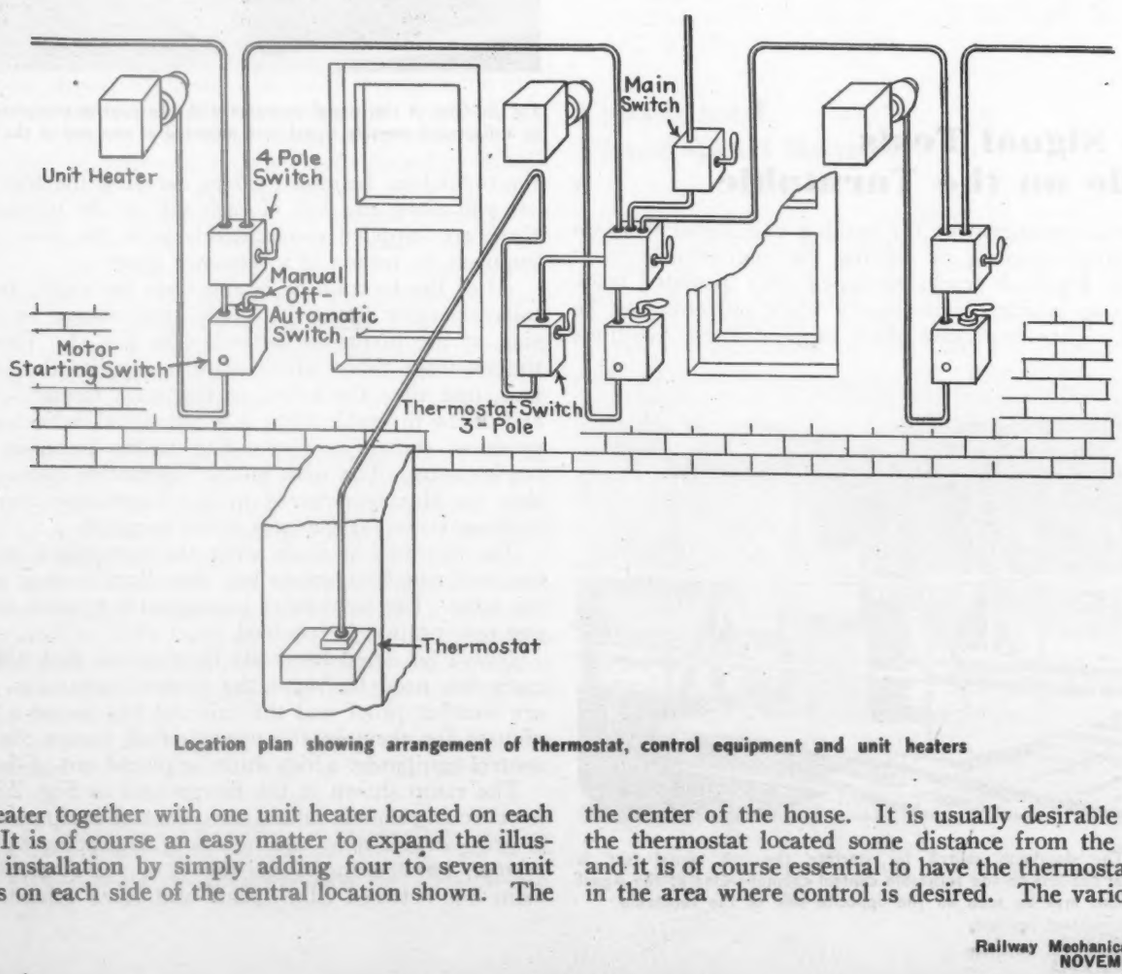
Control of Unit Heaters For Enginehouse Heating

One modern way to heat any large industrial area is by means of unit heaters. A locomotive enginehouse is no exception to this rule. To be sure the rigors of enginehouse service, such as smoke and gas, are especially hard on unit heaters as well as on the equipment used to control their motors. Furthermore it should not be forgotten that unit heaters, like any other type of equipment, must be properly maintained in order to retain their original efficiency. Nevertheless, unit heaters when properly installed and adequately maintained will prove themselves not only satisfactory, but also economical devices.

The control of a large group of unit heaters is a problem for the electrical department to solve. One method of accomplishing this is to control all heaters, which are located in one section of the enginehouse, from one of two master thermostats, but at the same time to provide local control for each individual unit. A wiring diagram and a location plan for such an arrangement are given in the sketches which form a part of this article. These diagrams show the master control for a centrally located unit heater together with one unit heater located on each side. It is of course an easy matter to expand the illustrated installation by simply adding four to seven unit heaters on each side of the central location shown. The only precaution which has to be taken is to make sure that neither the wires nor the control devices are overloaded.

The location plan shows the control equipment together with the unit heaters mounted on the inner face of the outside wall of the enginehouse. The unit heaters and other equipment are placed on pilasters between the windows. In some cases it will be desirable and necessary to install a unit heater at every pilaster, while in other cases one unit heater on every other pilaster will suffice. The decision as to how many units are needed can best be made by a study of the number of B.t.u. required by the house for the minimum outside temperature which is expected. Any heating sales engineer will be more than glad to help make this important decision.

It will be noted that sketches show the thermostat control as being placed on one of the posts located toward the center of the house. It is usually desirable to have the thermostat located some distance from the heaters, and it is of course essential to have the thermostat placed in the area where control is desired. The various elec-



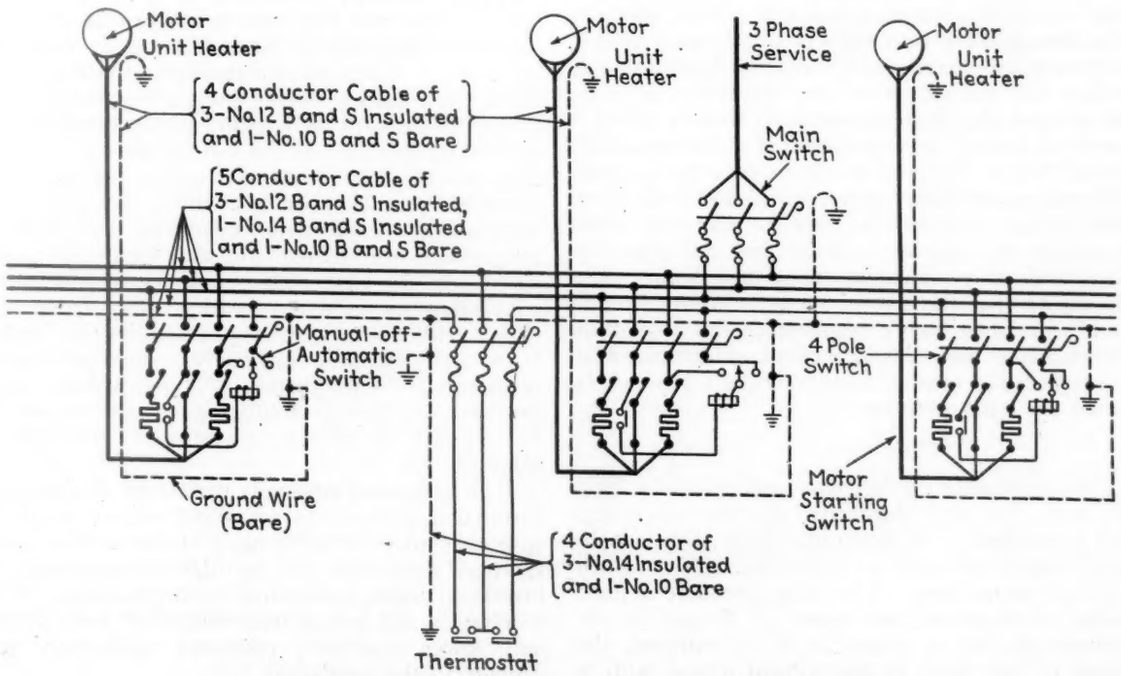
Location plan showing arrangement of thermostat, control equipment and unit heaters

trical units are shown connected by means of cables. Cables similar to service entrance cable has been found to be very satisfactory when used in enginehouse service. The cable required for an installation similar to that shown will have to be obtained on a special order in view of the fact that the cable sizes specified are not standard stock items. With this in view the diagrams have been marked in order to show the number and size of conductors required for each run.

The service cable can be made up of any sized wires depending on local conditions, but it is suggested that nothing less than three-conductor No. 8 B. & S. be used. The distribution circuit uses a five-conductor cable which contains three No. 12 B. & S. gauge conductors as the 220-volt feed for the motor-starting switches, one No. 14 B. & S. insulated conductor as the control wire, and one bare No. 10 B. & S. conductor as the means for grounding all units. This ground wire is essential when cable is used, otherwise the various units of the system might become dangerously charged. Since in some sections of the country the laws are more rigid than in others, it is important to remember that the suggestions as to the size of conductors should be increased where local conditions require.

If we assume that the motors furnished with the unit heaters are one-half horsepower, three-phase, 220-volt units, then the electrical equipment needed to equip three complete stalls of an enginehouse is as follows: two 30-amp. 220-volt, three-pole safety switches (for main and thermostat); three 30-amp. 220-volt, four-pole, non-fused safety switches; three 220-volt, three-pole coil-operated, across-the-line motor starting switches equipped with over-current protection of the proper rating for ½-hp. motors; three "manual-off-automatic" control switches; and one 220-volt, double-pole, single-throw thermostat of the proper current carrying capacity to carry the load of the coils in the motor-starting switches.

A four-pole switch is necessary at every motor location in order that the control circuit may be opened every time that the starter is disconnected from the line. If a three-pole switch were used, someone opening the three power wires might think the motor-starter switch to be completely de-energized, whereas in reality the control circuit might still be alive. The manual-off-automatic switches may be eliminated, if it is thought that sufficient control can be obtained from the thermostat, but it has been found from experience that workmen differ as to the amount of heat they need. Furthermore, if the manual-off-automatic switch is located in a locked box or is one of the lock type switches, it provides an excellent means of supervising the heating system. With lock type switches a foreman can "lock out" or "lock in" any unit heater.



Wiring diagram showing the master control and three heater controls

Most unit heater installations will have some type of pump for returning the condensate to the boilers. If this pump is motor driven it may be connected to the three No. 12 B. & S. conductors in the distribution cable and thus save the expense of running a separate circuit just to take care of the pump.

FORD C. PETHICK

* * *

Electrically-operated transfer cars carry coal from road car dumpers to ship loaders on the Virginian, at Sewalls Point, Va.

Drying Out Electrical Machinery

A number of our a.c. and d.c. machines remained submerged for four days during a recent flood. What is the easiest way of restoring these machines to service?

Circumstances Control The Method To Be Used

The easiest way of restoring to service a.c. and d.c. machines or their control equipment which have remained submerged for four days is largely governed by the facilities readily available for drying, reconditioning and testing and the extent of the urgency.

Water-soaked electrical apparatus is usually dried in some sort of heated drying oven before being placed in service. When the emergency is very great, however, low-voltage machines may even be hurriedly freed from mechanical obstructions such as mud and other foreign matter, the bearings relubricated and placed in operation, preferably unloaded for a few hours. Experience shows that the use of modern insulating materials and varnishes highly resistant to the absorption of moisture make this drastic method of treatment in some cases possible until a more thorough job can be done when the time permits.

Cleaning

Water is a conductor of electricity and its conductivity increases with dirt and chemicals. Flood waters contain such impurities. The apparatus must therefore be completely disassembled and all parts thoroughly washed with a high-pressure hose. The water pressure applied to insulated parts should not exceed 25 lb. per sq. in. Where chemicals, oil or grease is to be removed, the temperature of the water or the solvent mixed with it should not exceed 190 deg. F. The parts are then wiped dry with lint-free clean cloths—not waste—with particular attention to insulation and shafts. If oil or grease still remain, the parts can be wiped with or dipped in a solution of naphtha, carbon tetrachloride or gasoline or their suitable mixtures. To prevent the formation of explosive or toxic mixtures when using inflammable solvents, adequate ventilation should be provided and potential sources of fire minimized. Sparks produced by striking metal tools, metallic spray nozzles and metallic parts of shoes should be avoided. Fire extinguishers should be within easy reach and the personnel should be familiar with administering artificial respiration.

Inspection

After cleaning and wiping, all parts should be carefully inspected and all defective or weakened parts renewed. Bearings, whether of the open or sealed construction, should be completely disassembled, thoroughly cleaned, dried and relubricated.

Drying

In drying electrical apparatus, the most satisfactory temperature is about 230 deg. F. If the control of temperature is not quick and positive, it is better to work at lower temperatures in order to avoid damage to insulation. Drying can also be carried out at temperatures lower than 230 deg. F. but the period of drying will be longer. This period usually varies from two to six days. A small or non-waterproof machine will absorb moisture and also dry in a shorter period than a large machine with a winding fully impregnated against moisture. In order to keep dry, insulation which has been dried, it is necessary to maintain a minimum temperature of about 105 deg. F.

Heat may be applied externally, internally or by a combination of both methods.

In applying heat externally, the type of heater to be used is usually determined by what is available. This may vary from a heated vacuum tank to a hastily rigged drying oven of sheet iron, wood or even building paper heated by any means from electric space heaters, warm air blown under forced draft, steam or hot water radiators, coal or oil stoves, or even open fires. The use of open fires and their fumes are usually avoided to minimize fire hazards and defacing of equipment and property. When circumstances necessitate the use of open fires, baffles should always be used to avoid contact of flame with the equipment. A ventilating opening should be provided at the top of the enclosure to allow the escape of moisture and gases. Adequate air circulation must be provided within the enclosure. The temperature of the oven should be constantly checked to prevent overheating and damaging the parts being dried. In the case of large machines, it is often more convenient to build the heating oven around the machines without the necessity of handling its heavy parts.

In applying heat internally, competent supervision is essential. The fraction of rated voltage applied to produce the drying circulating current should be kept low enough to prevent current flow through the insulation.

Heat generated internally cannot be dissipated readily. Internal heat produces gases and vapors which may injure insulation in escaping. Moisture also lowers insulation resistance and at high temperatures renders insulation more susceptible to breakdown. While the winding is still wet, a temperature of even 212 deg. F. may lower insulation resistance sufficiently to cause damage to the insulation.

In the case of low-voltage equipment, drying is often omitted, especially when the equipment is needed urgently. After a thorough cleaning and inspection, the machine is reassembled and operated unloaded at reduced voltage until forced ventilation and internal heat caused by a limited circulating current dry out the windings and insulation. The insulation resistance first drops due to the inverse temperature characteristic of insulation and moisture, then rises as the insulation dries out. As the insulation resistance rises, the applied voltage may be increased until rated voltage is reached. The machine is then operated at rated voltage and no load until an insulation resistance of 1 megohm per 1,000 volts operating voltage is reached. For machines with operating voltage less than 1,000, the minimum insulation resistance is also 1 megohm.

Some parts of electrical equipment are harder to dry than others and require more attention; for example, coils wound with many turns of relatively light wire such as d.c. field windings, contactor operating coils, and transformer windings. Commutators are also hard to dry.

The most satisfactory method of drying coils and commutators is the hot vacuum process. This apparatus can only be installed and economically operated in a manufacturing plant or large repair shop where frequent use will warrant the investment in equipment and maintenance of competent operating personnel.

The next best method of drying coil insulation and commutators is the combined external and internal heat method but, in this case too, the investment required in responsive temperature control and its accurate measurement together with the competent operating personnel

may be too costly an installation for the average requirement.

Oven drying is probably the most economical method. Where a permanent oven installation is available, electrical machines operating in damp locations as well as submerged apparatus may be economically dried and reinsulated.

In the case of oil-cooled transformers, the tank may be drained and converted into a drying oven. Heated air is blown through the bottom oil valve and allowed to pass through the ducts and around the windings. The moisture-laden air is then discharged through an opening at the top. The temperature, measured by the resistance method, is kept under close observation to avoid damage to windings and insulation.

When a commutator in operation is suddenly cooled by cold flood waters, a considerable amount of moisture or water may be absorbed into it. In removing this moisture or water, it is sometimes necessary to provide a drain hole. This may be done by removing some bolts or nuts holding the commutator together. When the V-ring is held with a threaded ring, the segments should be held together with one or more clamps in order to maintain the smooth surface alignment when removing the V-ring. Heated air is then blown through these openings or the commutator is placed in a drying oven and then temperature constantly checked to avoid injury to the insulation.

Insulated cables may be dried with circulating current or by applying external heat. In the case of cable insulation containing rubber, a temperature of 140 deg. F. should not be exceeded.

When the apparatus is in the process of drying, Megger readings should be taken periodically. Any winding that fails to register a satisfactory insulation resistance after a reasonable length of time of constant temperature drying, may be considered to have developed a permanent fault and should be investigated closer for the possibility of removing such fault or, if necessary, of rewinding.

Testing

While the actual value of insulation resistance varies greatly in various types, sizes, voltage ratings and insulating materials of electrical apparatus, the relative values of these resistances when dry and when subjected to moisture and other destructive influences, are of major significance. The trend of the change in the value of insulation resistance rather than its actual value is to be considered. A satisfactory insulation resistance test is therefore considered sufficient for replacing an apparatus in service.

In the case of coils, it is important to note that a high resistance Megger reading does not always preclude the possibility of shorts between turns. After a winding tests clear, therefore, it should be connected in series with similar coils known to be in good condition and its resistance compared by the drop method.

A high-voltage dielectric test is not ordinarily applied to such reconditioned machines. If required, however, such a test should be made when the insulation is cold and its dielectric strength relatively higher.

Operation

The dried and tested apparatus is finally reassembled completely, lubricated if necessary, and energized, if possible, at reduced voltage; then at rated voltage, without load. The load is then applied gradually and the machine kept under observation for some time.

R. G. Cazanjian,
Electrical Engineer,
Brooklyn, N. Y.

* * *

Two 380-hp. 44-ton G-E Diesel-electric locomotives being used in multiple-unit operation for heavy switching requirements

EDITORIALS

Association High Lights

Organizations of men develop individual characteristics by which they can be recognized that are almost as distinctive as the qualities distinguishing individuals from each other. Of course, the obvious distinctions among the four so-called coordinated mechanical associations are the fields of their activity. But beyond them there are differences of outlook which are reflected in the character of at least a part of the work each association has done during the past several years.

Such a characteristic which comes to mind with respect to the Master Boiler Makers' Association is the consistency with which its program each year has contained at least one topic which reaches out to broaden the outlook of its members beyond the bounds of their own immediate interests. During the past five years the members have learned something of the functions of the federal Committee on Apprenticeship of the United States Department of Labor; of a steam-generating research conducted at Purdue University, and of boiler feedwater treatment and its relation to corrosion and maintenance. The members have been kept abreast of current theory with respect to caustic embrittlement. They have been informed of advanced engineering data which may influence future locomotive boiler design.

The Railway Fuel and Traveling Engineers' Association has also displayed a similar broad outlook in becoming a forum for the consideration of the future possibilities of the gas-turbine locomotive. The persistent effort of L. P. Michael's committee in exploring the various engineering details has been instrumental in spreading the conviction that the gas turbine has a bright future as a locomotive prime mover. This association has two heritages—one from the old International Railway Fuel Association and the other from the former Traveling Engineers' Association. It honors both ancestors in the influence it is exerting toward the improvement of railway fuel statistics and in its leadership in the dissemination of knowledge and enthusiasm for the intensification of locomotive utilization.

The Car Department Officers' Association has inherited the tradition of a long period of useful service rendered by the Chief Interchange Car Inspectors' and Car Foremen's Association. While its program is much broader than that of the old association, it still renders the same useful service of culling out and recommending needed changes in the Interchange and Loading Rules to committees of the Mechanical Division of the A. A. R. which formulate the recommendations for the official action of that body.

The Locomotive Maintenance Officers' Association is a relatively new body which came into being after its predecessor, the old International Railway General Foremen's Association, had been inactive for some time. It can scarcely be said to have inherited any useful tradition from that body and seems to be having some difficulty in finding itself. That there is a definite field within which it can function usefully is clearly demonstrated by the discussions of six questions pertaining to locomotive maintenance presented elsewhere in this issue.

Present conditions, no doubt are greater handicaps to the continued functioning of a new organization with a short background of experience than they are to the older and better established organizations. None of these bodies can continue to carry on successfully without the willingness of the officers and many of the members to do its work at real personal sacrifice. The useful service they can render, both to the railroads and to their members, should be the source of ample inspiration and personal satisfaction to assure the continued operation of all of these associations always provided, of course, that these leaders have a clear vision of the opportunity.

Suggestions From Employees

There is nothing new about employee suggestion systems which are being used with varying degrees of success both by general industry and the railroads. The General Motors Corporation, for example, received 134,657 suggestions and made 20,783 awards, totaling $814,553 in war bonds, in the 17 months ending August, 1943. The Illinois Central initiated an organized plan which, in the 21-month period between June, 1937, and March, 1939, produced only 1,135 suggestions of which 29 proved practicable and were the basis of cash awards totaling $475. The lack of complete success in this initial attempt on the I. C. was laid to a poor set-up which did not provide proper channels for the consideration of suggestions, which lacked necessary publicity to enlist the interest of employees, and which provided inadequate monetary recognition to award winners.

In an address before the September meeting of the Chicago Car Foremen's Association, H. C. Marmaduke, present manager of the I. C. Employees Suggestion System, said that the prospects for enlisting employee interest and improving management-employee relations through a suggestion system are unlimited, based on the sound theory that the man behind the wheelbarrow, engine lathe or desk knows more about his particular job than anyone else. Once his interest is aroused and he is given both an opportunity and

an incentive to suggest and develop worth-while ideas, not only will safety and working conditions be improved but the company's products and services as well.

Instead of operating as a company-committee plan, the present I. C. suggestion system has been functioning with notable success for over a year as a joint labor-management plan designed to stimulate the production of transportation badly needed in the war effort. In Mr. Marmaduke's experience, six cardinal principles which are necessary to the success of any suggestion system include: "Complete anonymity on the part of the employees making the suggestions up to the time awards are announced; the active enthusiastic backing of topflight management, utmost fairness and thoroughness in the consideration of ideas; generosity in the making of awards; full-time supervision; and most of all, company-wide faith in the plan, combined with a willingness on the part of all actively engaged in its direction to work hard and long to put the enterprise over."

The "proof of the pudding is in the eating" and the suggestion plan now followed by the Illinois Central has resulted in increasing the number of suggestions received from 16,092 in 1939 to 21,545 in 1942, with more than proportionate increases in 1943 to date. The number of awards made on the basis of suggestions received was 1,147 in 1939 this number being increased to 3,166 in 1942. The amount of money authorized to cover these awards increased from $10,565 to $35,120 in 1942 or an average of a little over $16 for each suggestion. A minimum award of $5 is paid for ideas of a minor nature, and suggestions which eliminate a hazard or otherwise increase safety of operation receive a minimum award of $10. There is no maximum award but where suggestions result in measureable savings, awards approximating 10 per cent of the gross savings for the first year are given to the employees responsible.

The experience of the Illinois Central with this suggestion system indicates its value in connection with the drive for war production. Typical of the ideas received are: the installation of electric lights on the footboards of new Diesel locomotives as a safety measure—intangible benefits, award $10; use of a die for punching instead of drilling slots in the throttle latches of certain types of locomotives—estimated annual saving $100, award $10; place lattice work over a cinder conveyor so constructed as to increase safety when the bucket is in the pit—intangible benefits, award $10; use special post or "old man" to increase efficiency when drilling trailer frames for fulcrum holes on certain classes of locomotives—estimated annual saving $250, award $25; rearrange slides over stoker troughs on locomotive tenders to avoid leaving coal in the tender with resultant deterioration, as well as to minimize the number of stops required to take coal, working conditions also being improved—annual tangible benefits $2,500, award $250; do away with all-copper hammers for inspection work and use instead soft-steel hammers with copper inserts in each end, this arrangement proving economical and at the same time saving copper for the nation's war effort—the savings were estimated at $2,200 per year and an award of $220 was made; a further check developed actual savings to be $2,877, and an additional award of $68 was made to the suggestor, total award $288; use industrial propane gas instead of artificial gas and thus reduce operating costs $4,000—award $400.

The suggestion system carried to its logical conclusion applies to all departments of railroads and also covers potentially the important field of inter-departmental relations. It deserves and, where successful, receives the support of both railroad managements and employee representatives who serve on the general committees and have voting power along with the railway officers on these committees. The objectives of reduced hazards, increased efficiency and money saved to be made available either for job permanency or increased employment are goals which everyone can agree on as desirable.

Others, Too, Are Working

Over a period of many years the work of the four mechanical associations has contributed greatly to progress on the railroads. In many instances they have been the prime movers in the adoption of new or improved practices which have added to efficiency of repairs or technical advances in design. For all of this they are to be commended and participating committee members thanked for the sacrifices in personal time which have been made in order that all might share in the knowledge and experience accruing from study and experimentation carried on in the mechanical departments of American and Canadian railroads.

There are, however, other sources from which equally valuable contributions have come and we feel that these efforts should also be called to mind in this issue which features the work of the mechanical associations. Private research as carried on by various supply companies and equipment manufacturers has done much to improve the quality and the performance of both motive power and rolling stock. University research laboratories have contributed to the development of improved materials, to improvements in equipment design, and to the sum total of engineering knowledge affecting the efficiency of railway operation. The A. A. R., through its committees, is continually investigating and testing the desirability of changes to improve design and performance.

Other technical societies of the country contribute directly or indirectly to the common fund of knowledge which is available to railroad men. The Railroad Division of the A. S. M. E. is among those whose work has been directed primarily to the dissemination of advanced knowledge pertaining to both theory and

practice of rolling-stock design. At its last meeting held in Chicago from October 18 to 21, the American Welding Society devoted a session to the consideration of welding and allied processes as applied to railroad needs. Other groups, while not as close to the railroad field, provide valuable factual information which is utilized in one way or another by the railways.

Attention is directed to these facts with no thought of minimizing the work of the associations, the reports of which are printed in this issue. It has been done, rather to suggest to what a great extent the railways are dependent upon organized efforts outside of their own operating forces for improvements in materials, for advances in the design of their own facilities and for improvements in practices.

Sometimes Scrap Is New Material

Since the outbreak of war and the consequent shortages of material there has been so much emphasis placed on the collection of scrap that we are sometimes inclined to wonder if there aren't many pounds of usable material getting into the scrap pile that could serve a much better purpose as basic material. Of course we know that no one would deliberately consign usable material to the scrap pile but it isn't the deliberate action that we are referring to in this case—it is the unconscious waste of material as a result of the careless design of parts, the allowance of too much finish for machining, the selection of a bar, billet or plate out of which to cut a part that requires too much material to be cut off and thrown away.

A case in point was observed in a large shop not long ago where scrap locomotive driving axles were used to manufacture a locomotive part the final finished weight of which was 336 lb. The original "scrap" axle weighed 1,386 lb. and in the process of cutting down an axle on a flame cutting machine to produce the parts ready for machining 504 lb. of metal were cut away and discarded as far as that particular operation was concerned. In the process of machining these parts to their final finished dimensions 168 lb. more were discarded in the form of chips making a total loss of material of 672 lb. or 48 per cent of the original material.

It is our belief that in such a case the necessity of "getting an engine out" plus the lack of new material unconsciously led to the use of the scrap driving axle which, being looked upon as scrap, was viewed only in the light of the solution to an immediate material shortage problem and not as a case in which basic material was used. Axle steel is still axle steel, even after it has reached the condemning limit as a driving axle, and it is only fair to say that while the job of getting a locomotive out of the shop is the major consideration the question should be raised as to whether or not the expenditure of some labor at the forging hammer in the smith shop might not have made it possible to deliver a billet to the machine shop out of which three, or even four of the 336-lb. parts could be made, instead of one.

Freon Now Available

Some railroads report that, after trying desperately and unsuccessfully all summer to secure necessary replacement supplies of Freon for air-cooling equipment in passenger cars, they are informed that authority can now be granted to purchase limited amounts of this precious fluid. As may be surmised, the permission comes too late to be of much help to railroads in 1943.

How many supposedly air-cooled cars had to be used with this modern facility inoperative during the summer of 1943 for lack of the Freon can only be surmised. At least one road found it necessary to unseal passenger-car windows which it had spent real money to make air- and dust-tight in the original design. Another road which proposed to install equipment for cleaning Freon and making it suitable for re-use was stymied because authority could not be secured to buy the special-purpose steel pressure tanks required for holding fluid as elusive as Freon.

The heavy hand of government regulation over private affairs is no less objectionable because it is essential in a war-time economy devoted to the primary objective above all else of winning the war. More government regulation than needed to meet this objective is a detriment to the country and its institutions.

New Books

METALS AND ALLOYS DATA BOOK, *By Samuel L. Hoyt. Published by Reinhold Publishing Corporation, 330 West Forty-second street, New York. 326 pages, 6½ in. by 10 in., illustrated. Price $4.75*

This book is a compilation of data on metals and alloys for metallurgists, engineers, students and others who have need for such information. It is a book designed solely for information, not for instruction. For that reason all of the descriptive matter has been left out and by concentration on data the large field of metals and alloys is comprehensively covered in a relatively small amount of space. After introductory chapters on test specimens and hardness tests the major chapters on wrought steels, cast and stainless steels, cast iron, corrosion- and heat-resistant alloys and non ferrous metals give, in tabular form practically any information that the user of metals would require. Chemical composition, physical properties, heat treatment, specifications, properties at low and high temperatures and the results of a wide variety of tests combine to make up the complete coverage of the several types of materials. Notes on uses and selection for specific purposes enhance the value of the book.

NEW DEVICES

Car Puller

A continuous-rope, double-drum-type car puller with a maximum capacity of 30,000 lb. rope pull is being introduced by the Whiting Corporation, Harvey, Ill. The rope is counterweighted to provide frictional pulling capacity; the counterweights

Car puller which can be used with overhead or pit counterweighting

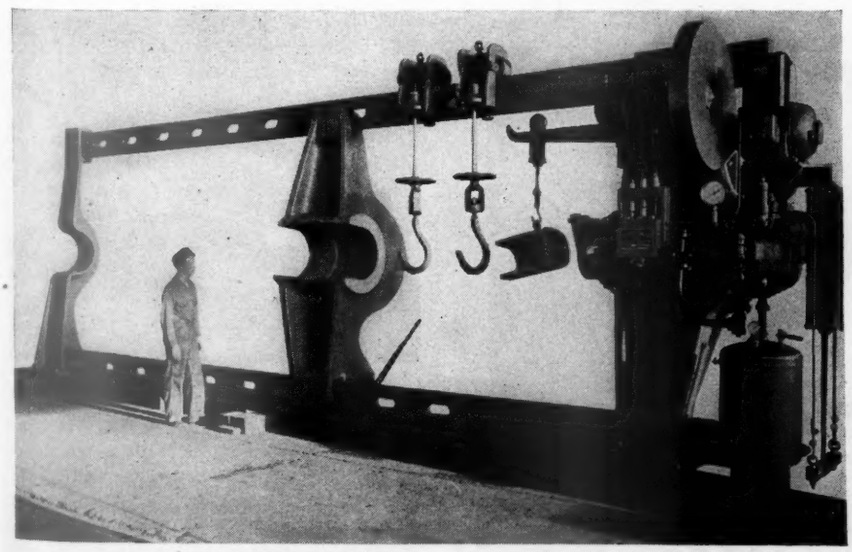
may be either the overhead type or pit type. The unit is built to fit within conventional track centers and is 4 ft. 5 in. in width. It is of all-welded construction and bearings are integral with the frame.

Hydraulic Wheel Press

The R. D. Wood Company, Philadelphia (5), Pa., has designed and built a self-contained hydraulic wheel press of 600 tons capacity. There are openings of 10 in. radius both in the resistance post and in the end post to accommodate work. The resistance post operates, on bearing equipped rollers, on the machined face of the base plate. This allows for easy movement in either direction. Where the use of a stop plate is necessary, a recess having an 11-in. radius has been provided in the resistance post, in which the plate is inserted.

The pump is of the vertical, triplex, two-pressure type. It has two high-pressure and one low-pressure plungers actuated by three eccentrics. The ram travel is 26 in. and its approach speed 70 in. per min. The ram speed at low pressure is 10 in. per min., at high pressure, 3¼ in. per min. The return speed is 40 in. per min. The maximum capacity at high pressure is 600 tons; at low pressure, 100 tons.

The press can be installed flush with the floor. A pneumatic pullback device is built into the machine which eliminates the necessity of providing a pit to accommodate counterweights and it is said to give a faster rate of ram return than is obtainable on ballast-weighted devices.

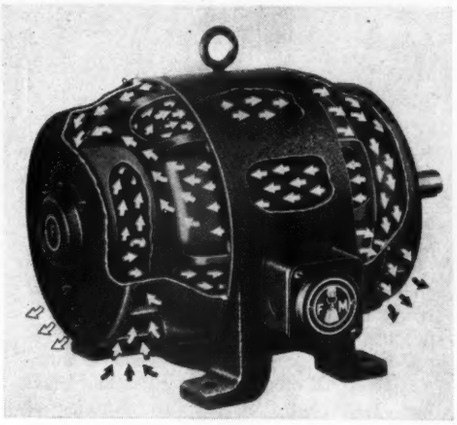


Wheel press having a 600-ton capacity

All-Purpose Motor

Fairbanks-Morse & Co., Chicago, has announced an all-purpose, continuous-duty, polyphase squirrel-cage induction motor for use in all kinds of industry. Constructed with the centrifugally cast F-M copperspun rotor, the motor is fully protected against flying chips, falling particles, dripping liquids, and other industrial motor hazards. The ball bearings are sealed in cartridge-type housings. Cross-flow ventilation, a feature in 1½-hp. to 34-hp. sizes, is obtained through protected inlets and exhausts at each end of the motor and is claimed to effect uniform cooling and the elimination of hot spots. The frame is cast in one piece with rib sections to give added strength without increase in weight.

Where space is limited, the conduit can be brought up between the motor feet to the tapped hole in the motor frame and



Sectionalized view of the F-M all-purpose motor showing direction of cross-flow ventilation

the conduit-box cover assembled flush with the frame. The external box is then discarded. When the conventional conduit box is used it can be mounted in any one of four positions.

The motor is rated 40 deg. C. and designed to carry 115 per cent load continuously without injurious heating.

Hydraulic-Ram Drive And Feeds on Slotter

The Hy-Draulic slotter manufactured by the Rockford Machine Tool Company, Rockford, Ill., has a 12 in. maximum stroke and will slot to the center of a 48-in. circle. Minimum space under the ram guide is 18 in. The cutting speeds on the machine vary between 10 and 75 ft. per min. A circular table 28 in. in diameter and graduated on the periphery, has T-slots in four directions. Micrometer dials graduated in thousandths of an inch show the exact movements of the table. Final drive to the table is through a worm and worm gear, with means provided for adjustment. In addition to rotary movement the table has a longitudinal and transverse travel of 26 in.

The slotter has hydraulic ram drive, manual and hydraulic longitudinal and transverse feed and a rapid power traverse. It also has manual and hydraulic rotary feeds to the table. The hydraulic feed to the table is infinitely adjustable between 0 and 0.106 in. per cutting stroke for transverse movement, between 0 and 0.053 in. for longitudinal movement and between 0

Hydraulic controls are a feature of this slotter

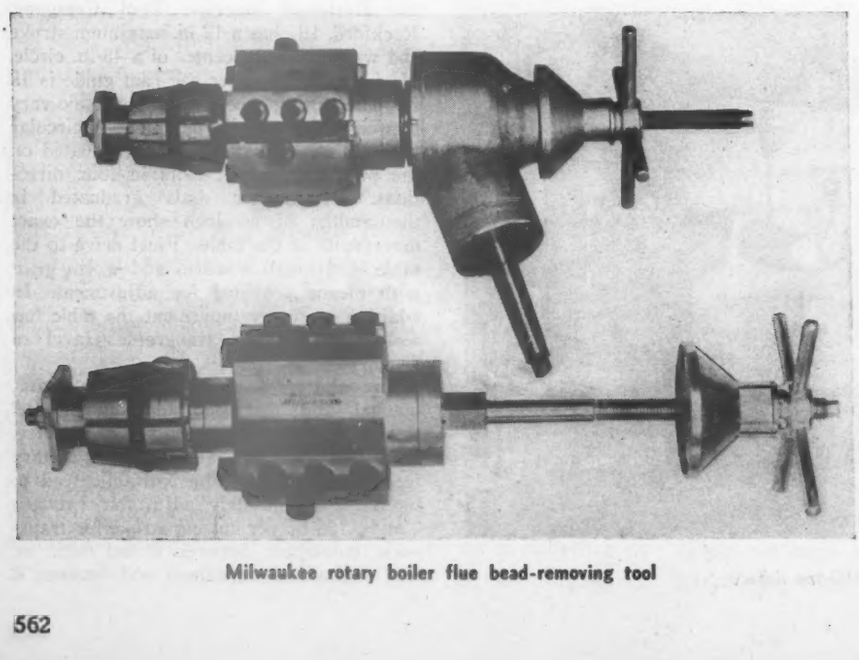
and 0.106 in., on a circle of 6 in. diameter for circular movement.

The main driving motor is a standard constant-speed electric motor connected directly to the hydraulic pumping unit by a flexible coupling. The hydraulic system is self-lubricating. Ram lubrication is automatic and all other moving parts and bearings have one-shot pressure fittings or other means for easy lubrication.

Boiler Flue Bead Remover

A Milwaukee rotary boiler-flue bead remover, recently placed on the market by Joseph Sinkler, Inc., Chicago, consists of a No. 50 motor gear angle drive unit mounted on the spindle feed rod of a three-cutter tool housing with a segmental expander which serves to center and hold the tool when it is inserted in the boiler flue. The multiple segments are held in place by a small coil spring in the usual manner. A ball thrust bearing is carried between the expander and the tool holder which is equipped with round recessed-head set screws for holding the tool bits. Power is transmitted through a motor-drive cap which engages both the angle drive unit and the tool holder. A view of the complete assembled tool is shown at the top in the illustration and without the angle drive unit below.

The cutting tools are ground with specified clearance and cutting rake and are set out all alike to the desired length from the holder by means of a tool-setting gauge which is furnished with the bead remover. When operating this tool it is recommended that care be exercised to have it firmly seated in the flue and the cutting operation continued until the tool bits have gone just deep enough to remove the beads and any pitting or scale on the face of the flue sheet. In this way the necessity of sand blasting or grinding before welding is avoided when new flues and tubes are being re-installed.



Milwaukee rotary boiler flue bead-removing tool

Spray Degreasing Booth

A spray degreasing booth intended for use in connection with solvent-cleaning operations has been designed for safe operation even with highly volatile solvents having a low flash point. It is said to remove fumes thoroughly and to deliver a forceful, hard-driven solvent spray. Available in various sizes the booths are constructed of flanged, mitered-corner sheet-steel panels which are bolted together. Deflector curtains run around the top and sides of the frontal opening.

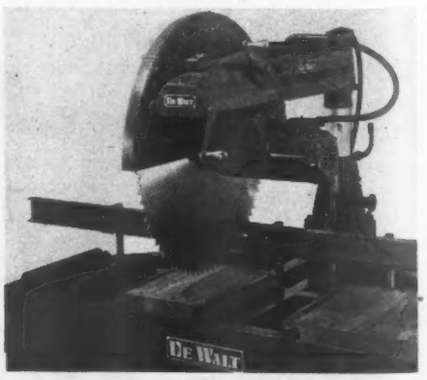
Wire-mesh filter packs, aided by three right-angle turns in the air path, trap the atomized solvent carried by the exhaust draft, which then drains back into a pan which forms the floor of the booth. Excess solvent from the pieces being degreased also flows into this pan through the openings in the spark-proof working surface which is a heavy oak grating. From the pan the solvent is drawn by a rotary pump,

Spray booth designed for safety and high solvent recovery

equipped with an explosion-proof motor, and forced through mechanical filters which clean the solvent and deliver it to the spray gun at the pressure required. Solvent losses are held to a minimum in this procedure. The DeVilbiss Company, Toledo, Ohio, is the manufacturer of this equipment.

Machines for Woodworking

A complete line of versatile woodworking machines manufactured by the DeWalt Products Corporation, Lancaster, Pa., are available for railroad use in planing mills

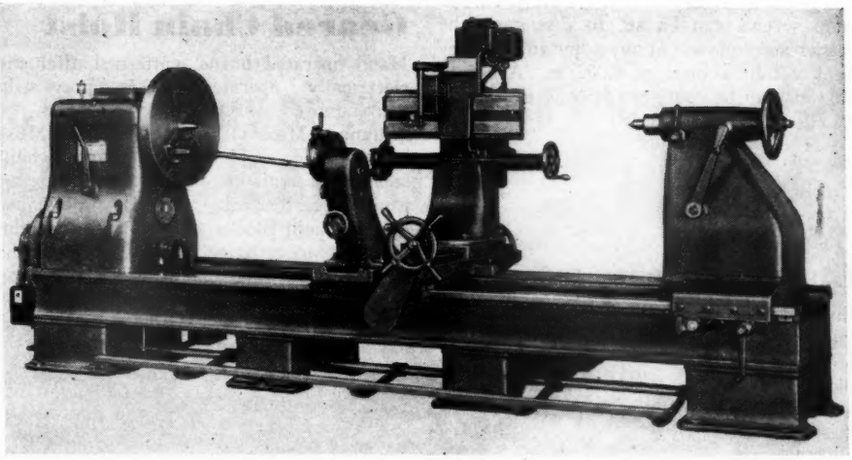


A wide variety of woodworking operations can be performed with this machine

or along repair tracks. The machines are so constructed that with three simple radial adjustments they can be made to perform almost any woodworking operation. A cantilever arm from which the motor unit is

suspended moves vertically and swings horizontally. A yoke moves along this arm and rotates horizontally; the motor can be tilted to any desired angle. This design provides for complete balance at all times because the weight of the motor is always in line with the center line of the yoke, arm and column.

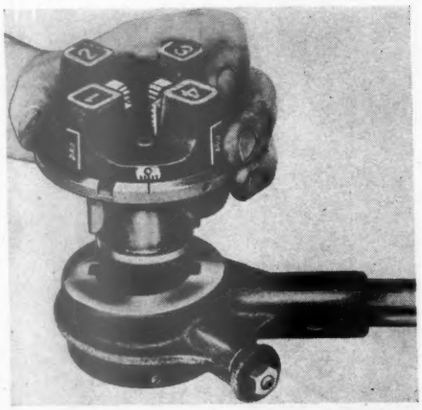
Small units mounted on movable trucks have been found valuable in saving material handling time on repair tracks and in shops because they can be spotted at or near the work under way to handle any necessary operations incident to the fitting of wooden parts.



An armature machine for the electric shop

Adjustable Pipe And Bolt Threader

A pipe and bolt threader in which complete dieheads, rather than loose dies are changed has been introduced by Beaver Pipe Tools, Warren, Ohio. This ratchet threader can be furnished with any or all of more than 100 different kinds and sizes of dies. The dies are fully adjustable for



Complete die heads are changed in this ratchet threader

cutting oversize or undersize threads and the adjustments are obtained by the use of an index which is a part of each diehead as furnished. Chips are said to clear easily and the dies can be oiled while the threading operation is being performed.

Heavy-Duty Armature Machine

The repair of large armatures, including banding, slotting, grinding and trueing of commutators, is facilitated by the use of a heavy-duty armature machine furnished by the Electric Service Suppliers Company, Philadelphia, Pa. The machine is capable of banding armatures up to 45 in. in diameter having shafts up to 96 in. long and provides a swing 47 in. in diameter over the carriage. The tension device will travel or feed to within 4 in. of the headstock centers and 8 in. of the tailstock centers.

The slow rate of revolution of the armature is 11 r.p.m., the fast rate is 80 r.p.m. Two selective mechanical speed changes are provided. It is possible to grind and true commutators 24 in. in diameter with a length of 16 in. The commutator undercutting attachment will handle commutators of from 5 to 30 in. in diameter and 19½ in. or over in length.

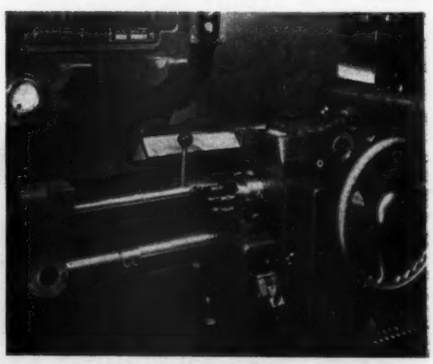
A.C. Arc Welder

An a. c. welder with a range of current from 30 to 250 amp. known as the Ampac 200 has been announced by the Allis-Chalmers Company, Milwaukee, Wis. This machine operates to give the operator correct voltage for the continuous range of currents available, rather than using almost constant voltage at all current settings. The unit is made with an integrated reactor-transformer construction to provide a high, but safe voltage for easy welding at low currents. As with other a. c. welders the problem of arc-blow is eliminated. The welder handles rods of 1/16 in. to ¼ in. in size and most d. c. rods as well as a. c. rods can be used successfully.

A-C welder with a range of from 30 to 250 amperes

Thread Chaser

The Warner & Swasey Company, Cleveland, Ohio, has developed a new thread-chasing attachment with automatic knockoff for use on the square turret carriage aprons on A-type turret lathes. The unit



Thread-chasing attachment with automatic knockoff mechanism

bolts onto the square carriage apron and is designed so that it can be installed on lathes of the company's manufacture which are now in service.

The automatic knockoff mechanism is operated by a spring-loaded latch which is tripped by the carriage stop roll. It provides much quicker disengagement than can be accomplished by hand. The carriage

stop screws can be set to disengage the leader and follower at any point and will repeat within a limit of 0.002 in. Accurate threads can be cut from 4 to 32 per in. up to 7¼ in. in length.

Lighting Units

Engine-generator floodlight and searchlight equipment manufactured by the Waukesha Motor Company, Waukesha, Wis., is adapted to use in railroad wreck and rescue work. The two most popular units are a floodlight combination of four floodlights, and a searchlight and floodlight combination having one searchlight and two floodlights. A model with two searchlights is also available. The floodlight combination has four lights, each of 60,000 candlepower with a beam spread of 40 deg. This unit uses 110-volt incandescent lamps and is mounted on a tubular welded steel frame. The searchlight and floodlight model has one trunnion-mounted searchlight of 4,100,000 beam candlepower, and two floodlights of 60,000 candlepower each. This is also mounted on a tubular welded steel frame and uses 110-volt incandescent lamps.

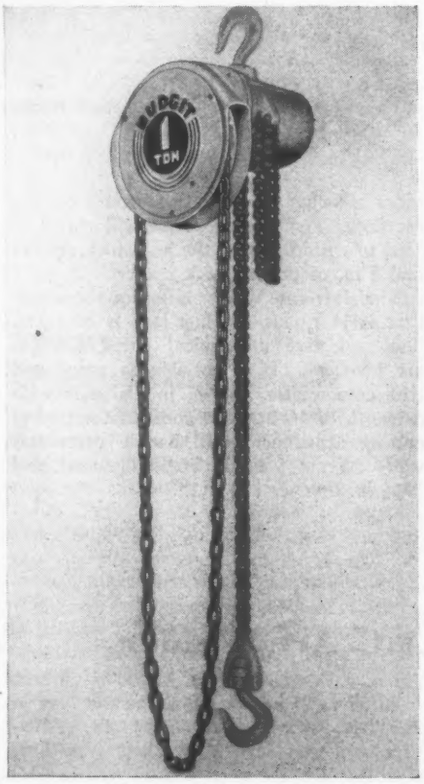
Press Brake

Large size press brakes have proved of value in the fabrication of parts for both freight and passenger cars. The Cincinnati Shaper Company, Cincinnati, Ohio, manufactures these machines, the largest standard size of which is a brake which has a capacity to handle stock 1 in. by 12 ft. over an 8-in. vee die making the bend in cold metal. Gang punching equipment can be installed in the brake to speed output and provide maximum accuracy of hole spacing. A wide variation in setups is possible.

Geared Chain Hoist

Hand operated hoists, patterned after the electrically operated hoists previously manufactured, are being marketed by Manning, Maxwell & Moore, Inc., Muskegon, Mich. These spur-geared chain hoists are available in capacities ranging from ¼-ton to 2 tons under the trade name Budgit Chain Blocks. They vary in weight according to capacity from 48 lb. to 81 lb.

The hoists have spur-gearing, anti-friction bearings on all shafts and a roller-type lift chain. The automatic load brake and other mechanism operate in a grease-packed sealed enclosure. The hand-chain wheel is housed in a steel enclosure and there is a chain guide which prevents the chain fouling on the wheel.

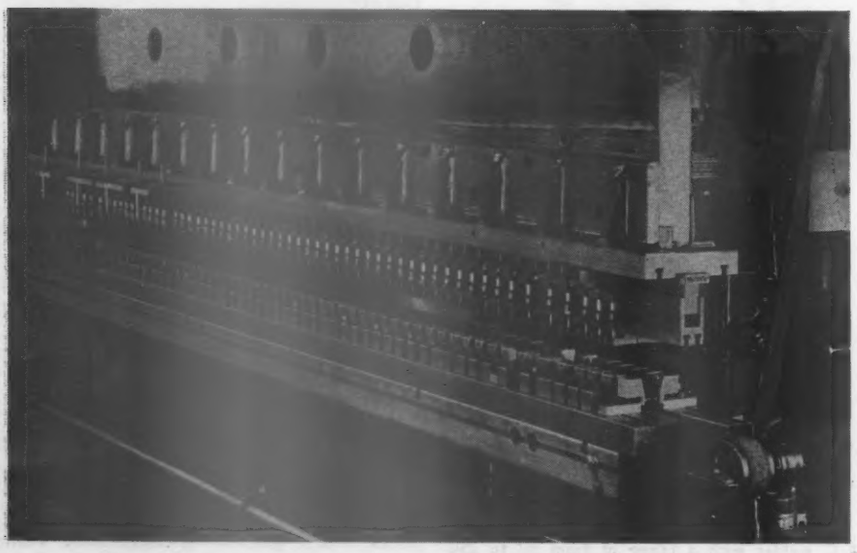


Chain hoists of this type can be obtained in capacities from ¼ ton to 2 tons

Rubber Bushings For Car Axle Pulleys

The Dayton Rubber Manufacturing Company, Dayton, Ohio, has developed a rubber bushing designed to facilitate the application of axle pulleys, to prevent pulleys from becoming loose, to eliminate rejection of axles due to marking and scoring by metal bushings, and to act as a rust-proof cushion. These bushings are said to be easier and quicker to install than metal bushings because both bushing and pulley are applied in one operation. No bolts, clamps or cement are required in their application to the axle; the bolts of the axle-pulley halves hold the bushing in place.

An axle pulley mounted over rubber bushings



Press brake, 12 ft. long, set up to punch two rows of holes in a carline

Horizontal Spindle Miller for Railroads

Slabbing, edging and end-slotting of light link motion parts, such as radius bars, links, eccentric rods and cranks, can be performed on the horizontal spindle milling machine shown in the illustration. The head and table of the machine have separate adjustable-speed motors and profiling operations can be performed by combining

(*Turn to next left-hand page*)

SIX TESTS* HAVE GUARDED THE QUALITY OF CHILLED CAR WHEELS

...NOW A 7TH HAS BEEN ADDED

To satisfactorily control the depth of chill is to ensure the *right* degree of hardness at the *right* place. Now, after 3 years' research and development, such control is possible by *instrumentally* determining chill with the Brinell Hardness Testing Machine. This test becomes the seventh requirement Chilled Car Wheels must satisfy before Association inspectors will permit them to leave any of our foundries. Thus, Chilled Car Wheel users are assured of still another control of quality.

The development of this new test demonstrates the continued efforts of Chilled Car Wheel manufacturers to produce a better wheel through rigid control supervision.

The six previously established control tests are:

1. Chill test block taken at least once in every ten wheels poured.
2. One complete chemical analysis block with each heat.
3. Constant pyrometer check for accurate processing temperature.
4. Drop test of finished wheel (A.A.R. Specifications).
5. Thermal test of finished wheel (A.A.R. Specifications).
6. Test for perfect rotundity.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

AMCCW

Organized to achieve:
Uniform Specifications
Uniform Inspection
Uniform Product

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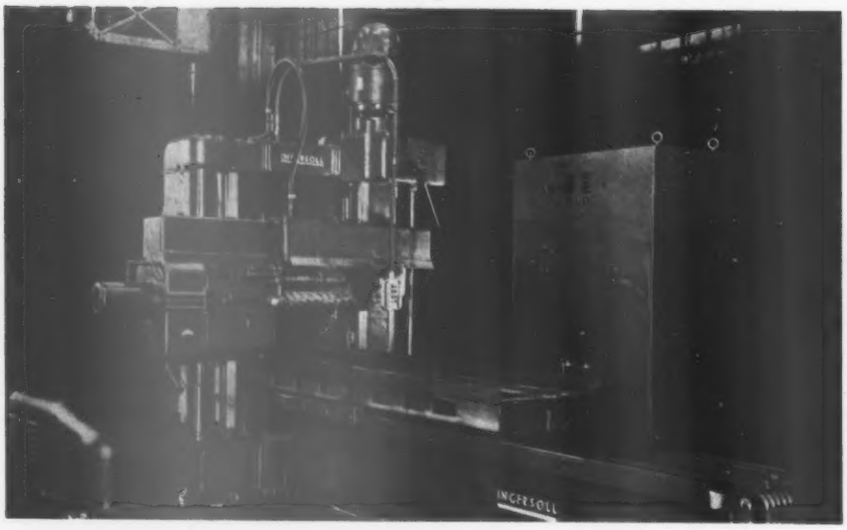

Link motion parts are readily worked on this horizontal spindle machine

head and table feeds in any ratio. The machine is equipped with push-button pendant control which permits speeding up or slowing down of the motors to assist in following scribed lines or templates. An over-arm extends across the table and mounts on the opposite housing. Large slabbing cutters and arbors are held in the arbor support and are adjustable along the over-arm. Ingersoll Milling Machine Company, Rockford, Ill., is the builder.

Universal Fixture For Grinding Dies

The grinding of all sizes, makes and types of dies and chasers is speeded by the use of a universal fixture built by the Oster Manufacturing Company, Cleveland (3), Ohio, for mounting on the table of any conventional tool and cutter grinding machine. The device is so constructed that it can be adjusted to provide for any throat or rake angle desired. The fixture is said to effect a considerable saving in the cost of dies and chasers ruined by the use of less exact methods of reclamation.

Adjustable fixture which provides any throat or rake angle when grinding dies

Adjustable Rotary Machine for Rod Work

An adjustable rotary machine for rod ending, channeling, trepanning, jaw and tongue milling and all contour milling operations

Rod milling machine with push-button control of table and head feeds

on locomotive rods is furnished by the Ingersoll Milling Machine Company, Rockford, Ill. Improvements which have been made in this machine include separate feed motors for the table and head which are controlled from a pushbutton pendant. By pushing a button, the feed to either is gradually increased or decreased as needed when following layout lines on various rod contours. Special fixtures and cutters are also obtainable.

Welding Positioner

Hand and motor-operated welding positioners of 500 lb. capacity have been designed by the Ransome Machinery Company, Dunellen, N. J. The work table has a tilting range of 135 deg. from the horizontal which permits downhand welding in all positions. Motorized units have a variable-speed drive providing a sp range up to one revolution per minute.

The table top is 26 in. in diameter is T-slotted to aid in clamping work pie to it. All gears are of the cut-tooth ty The machines are furnished with either

Welding positioner adaptable for work weigh ing up to 500 lb.

regular base for bench work or with a sub base which is adjustable to between 27 in and 42 in. from floor to table top.

Welding Torch Nozzles

Initially produced for aircraft welding Victor Airadiator welding-torch nozzles are now available in all sizes and for all models

Victory welding torches are obtainable in a variety of sizes

of the Victor welding torches. These nozzles are said to have proven very successful in limiting overheating and are recommended particularly for heavy brazing operations or welding in confined spaces where tip and nozzle overheating causes difficulties. The Victor Equipment Company, San Francisco (7), Calif., are the manufacturers.

(*Turn to next left-hand page*)

LIMA LOCOMOTIVES PLAY THEIR PART

in helping the C. & O. to move more coal

While the operating records of the Chesapeake & Ohio show that miles per serviceable freight locomotive increased by 5.4% in 1942 over the excellent showing of 1941, revenue ton-miles stepped up by 13.3%—an even clearer indication of the heavier service performed by C. & O. freight locomotives during each mile of their increased daily rounds.

A substantial part of this increased load was carried for the C. & O. by Lima-built locomotives, including the "Allegheny Type" 2-6-6-6 articulated superpower Lima steam locomotives. Twenty of these were recently delivered by Lima to the C. & O., and ten more are now being built for this railroad by the Lima Locomotive Works.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED **INCORPORATED, LIMA, OHIO**

High Spots in
Railway Affairs . . .

Railroaders Commended

J. J. Pelley, president of the Association of American Railroads, recently received a joint official expression from Robert P. Patterson, Under-Secretary of War, and James Forrestal, Under-Secretary of the Navy, expressing appreciation to the men and women who work on American railroads, for the splendid job they are doing. "Since the outbreak of the war," says this letter, "the railroads have hauled 76 million carloads of freight, most of it destined for battle fronts. Millions of fighting men have been transported to training camps and embarkation ports. The Army and Navy realize that, to perform this big job, crews on trains, in shops, in yards, and along rights-of-way have had to work long and hard. To the men and women who have made this record movement of men and weapons possible, the Army and Navy are deeply grateful. Keep up the good work—for railroad work is war work, railroad service is vital to victory."

Freight Loss and Damage Increases

It is only natural that the loss and damage to freight should increase with the growing war traffic, coupled with the manpower shortage and the siphoning off of trained railroad workers into the war services. It is unfortunate, however, that these losses should increase when the war and civilian demands are so great for all types of materials and commodities. For the first six months of this year the loss and damage claims paid by the railroads amounted to $18,744,123, as compared to $15,572,717 for the same period of 1942. This is an increase of 20.4 per cent, or almost the same as the percentage increase of revenue tons of freight carried for one mile, for the same period.

Hospital Cars

The Pullman Company is completing the conversion of an order of cars for the Medical Department of the Army. Pullman sleeping, parlor and lounge cars have been converted into air-conditioned traveling hospitals, each with a capacity of about 30 patients. Fifty-eight of the cars are each equipped with 32 folding-type beds in two tiers. They may be folded against the wall for car cleaning and renovating purposes and may be also converted into seats for the daytime use of convalescent patients. These cars have washrooms, toilets and a receiving room, with a special loading door for stretcher cases. Twenty-eight of the cars have 15 double-deck beds, with a capacity of 30 patients. The receiving rooms of these cars are equipped with operating tables, sterilizers, instrument cabinets and medical washstands. Two cars, known as "unit cars", are equipped with large kitchens, personnel quarters, dispensaries, offices and dressing rooms, with facilities for emergency operations.

Lt. Col. Okie Again Honored

Lt. Col. Frederick W. Okie, former division superintendent of the Southern at Birmingham, Ala., commanding the 727th Railway Operating Battalion, which has rendered brilliant service in the North African and Sicilian campaigns, has been awarded the Soldiers' Medal for extraordinary heroism, not in action. He had formerly received the Legion of Merit Medal for personal valor, as noted in the *Railway Mechanical Engineer* of September, 1943, page 440. The new medal is the result of his action when fire broke out in a captured railroad freight station, full of enemy ammunition, incendiary grenades and other explosives. "With utter disregard for his personal safety," the citation stated, "Colonel Okie supervised and assisted in coupling and removing cars of American ammunition, rations and bridge material, from which shells were exploding in all directions. His actions, even though in danger of death or injury from flying fragments, resulted in the saving of much badly needed supplies, and prevented serious damage to vital railroad facilities."

What the Public Thinks About Transportation Agencies

Each year, for the past three, the Opinion Research Corporation of Princeton, N. J., has reported on the state of public opinion toward the railroads. It is of special interest to note the appraisal of the different agencies of transportation, on the basis of the importance of their contribution to the war effort:

	July 1941	July 1942	July 1943
Railroads most important, per cent..	68	83	90
Trucks most important, per cent....	22	13	8
Barges most important, per cent....	10	4	2

Only five per cent of those questioned expect government ownership of the railroads following the war. A rather disturbing tendency noted by the research workers who made the survey was the fact that 39 per cent of those questioned this year, who were critical of railroad employees, cited rudeness as their cause of complaint, as compared to only 16 per cent last year. It was also found that young people are the least appreciative of railroad performance and are the most critical of railroad policies.

Military Railroad Men

The New York Times recently had this to say of the performance of our Railway Operating Battalions: "Among the prizes of the Sicilian campaign were some 300 locomotives and 3,000 cars, two-thirds of them in good order. Among these were a large number of new German cars. Brigadier General Gray, director general of the Military Railway Service, said the other day that British and American railway men were operating 420 miles of track the third day after the first landings. Yesterday (September 27) a dispatch from North Africa told that the American Army's 'crack 727th Railway Operating Battalion' had been cited by General Patton for its skill and swiftness in running Sicilian trains under fire. . . . There is a West Point at Fort Slocum (N. Y.) where dispatchers, engineers and machinists are trained to be officers. It would be ungrateful to forget such officers and the men they command. Their service isn't showy, but it is indispensable."

Train Accidents and High-Speed Operations

Joseph B. Eastman, director of the Office of Defense Transportation, reported to the New England Shippers' Advisory Board at Boston, Mass., on October 6, on "the state of the nation, so far as railroad transportation is concerned". In the course of his address he said, "It is undoubtedly true that with the present tremendous volume of traffic and the high pressure under which the railroads are operating, the accident rate has somewhat increased. But nothing within my knowledge leads me to believe that any state of negligence or carelessness has yet developed on the part of either the managements or the men, or that the equipment is not generally being maintained in condition for safe operation." He referred to the fact that as a result of his request, the railroads had make a check of their passenger train running time in the latter part of 1942. This resulted in a considerable number of schedule changes, all of which resulted in slower running times. The matter is now being re-examined. "It is not a matter which can be dealt with arbitrarily or peremptorily," said Mr. Eastman, "for the changing of railroad schedules is full of complications. . . . Railroad travel may still be regarded as safe, and certainly far safer than highway traffic."

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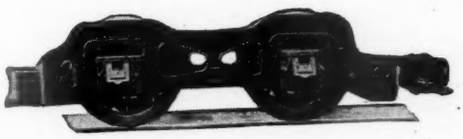
Booster Power

KEEPS TRAFFIC MOVING



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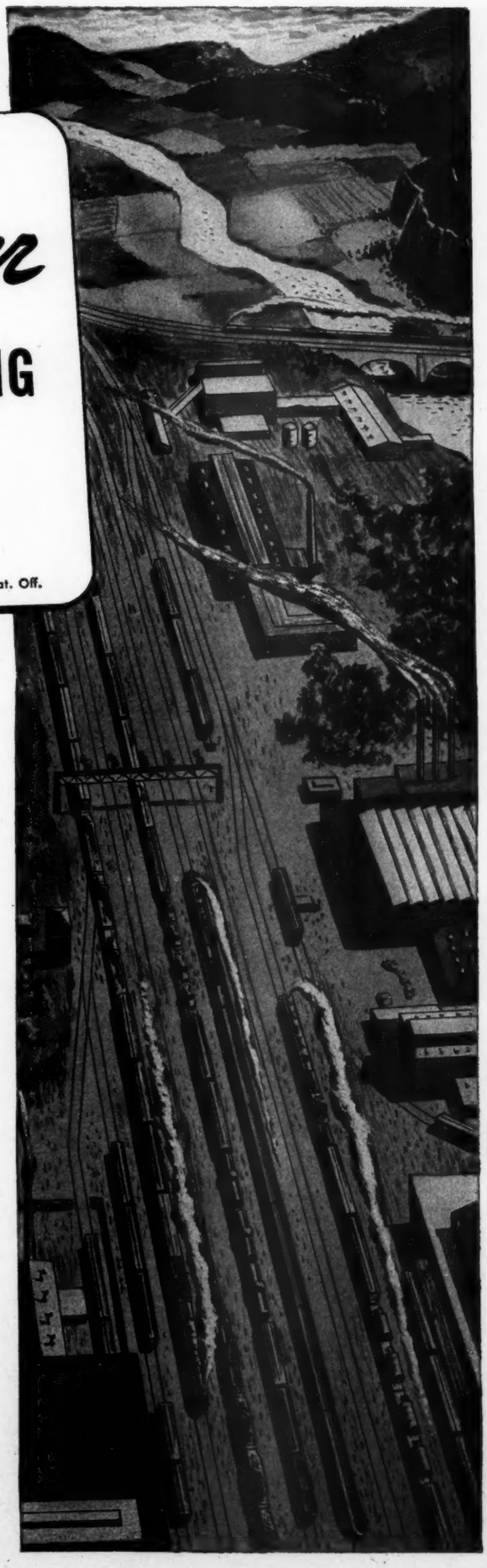

The Booster* gets heavy trains in and out of sidings in half the time. Its added power gets you out of any tight spot.

Veteran engineers call the Locomotive Booster a friendly ally and bear witness to hundreds of instances where its extra power has speeded up wartime traffic.

The Locomotive Booster makes everything else more productive.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

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NEWS

Advanced Car Authorizations Aid in Planning Production Schedules

THE Office of Defense Transportation is reported to have drawn upon authorized advanced allotments of steel for the first six months of 1944 to release 8,467 new freight cars, of which 5,762 were authorized for building out of steel allotted for the first quarter of next year and 2,705 out of steel allotments for the second quarter. Additional cars will be scheduled upon additional authorization being received for materials for this period, both from the current backlog of cars on order but not yet authorized for building and from a number of new orders now pending.

The practice of allocating new car construction in advance from future materials' allotments under the War Production Board's controlled materials plan is designed to aid car-building plants in planning production schedules and also to hold down the accumulation of a large backlog of unauthorized orders. Breakdown of the 8,467 cars newly released by railroads, number, type and builder is shown in the accompanying table. The authorizations for the building of the majority of these cars have previously been reported individually from time to time in these columns.

Most of the 5,762 cars released for the first quarter, 1944, or 3,052, are scheduled for construction in railroad shops, including 800 box, 1,800 hopper, and 350 gondola cars, and 102 cabooses. The remaining 2,710 to be built by contract car builders include 500 box, 1,350 hopper, 625 gondola and 200 flat cars and 35 cabooses. The 2,705 authorized from second quarter materials comprise 800 hopper and 1,000 gondola cars on order with contract builders and 255 box, 600 hopper and 50 gondola cars on order with the railroads' own shops.

With the new releases, the backlog of cars authorized for building now totals 30,500, including 100 automobile, 6,802 box, 16,893 hopper, 4,416 gondola, 1,548 flat, 216 tank, 225 caboose and 300 refrigerator cars, of which about 19,700 are scheduled in contract car building plants and 10,800 in railroad shops. This backlog is made up of about 6,000 cars remaining to be shipped of the War Production Board's 20,000 car-program for the first six months of 1943, 5,900 authorized for building from third quarter, 1943 materials, 10,100 from fourth quarter, 1943 materials and the approximately 8,500 from first half, 1944 materials.

The number of these cars that will be delivered by the year-end depends on how much material is made available. There is a natural time-lag before allotted materials arrive at car-building plants and can be converted into completed cars. It is expected that all or most of the 10,100 cars authorized for the fourth quarter of this year, and probably some third quarter cars, will be carried over for delivery in 1944. The year-end backlog would thus comprise these 10,100 or more cars, the 8,467 already authorized for the first six months of 1944 and such additional authorizations as are subsequently made, and will include cars scheduled for delivery as far in advance as the third quarter of 1944.

There remain about 11,100 cars on order not yet released for building of which 8,400 are on car-builders' books and 2,700 with railroad shops. Among the larger of these placements are the Atlantic Coast Line's order for 1,100 box cars with the Pullman-Standard Car Manufacturing Corporation; the Baltimore & Ohio order for 1,000 box cars with the General American Transportation Corporation and 1,000 hopper cars with the Bethlehem Steel Company; the Chicago & North Western order for 500 ore cars with Bethlehem; the Reading's order for 1,000 gondola cars with the railroad's own shops; and the Southern's orders for 1,052 hopper cars with the Pullman-Standard and 550 box and 400 automobile cars with the Mount Vernon Car Mfg. Co.

Journal Failure Cause of Congressional Ltd. Derailment

THE direct cause of the derailment of the advance section of the Pennsylvania's "Congressional Limited" within the corporate limits of Philadelphia, Pa., on September 6 was, according to the report of the Interstate Commerce Commission, a broken journal on the seventh car of the 16-car train. The then available data indicated that the accident resulted in the death of 78 passengers and 1 dining car employee and in the injury of 102 passengers, 5 Pullman employees and 22 dining car employees.

The immediate cause of the derailment was the failure of the left front journal of the front truck of the seventh car, P. R. R. 1860. After the accident it was found that this journal was broken off, the fracture varying from 7¼ to 7⅞ in. inward from the collar. The end of the journal remaining attached to the wheel assembly was ground down to an oval shape by contact with the journal wedge, but there was no evidence of cutting on the outer portion. The journal box was demolished, but a portion of the outer end of the bearing was recovered. It showed no lining metal remaining on the bearing surface.

When examined 1½ hr. after the accident the journal was heated considerably above normal running heat, the report discloses. Furthermore, tests and analyses of the journal and bearing indicated that the journal had been heated to a temperature of at least 900 deg. and its surface temperature had reached some 1,400 deg. The shallowness of the structural change resulting from this high temperature indicated that the heating occurred very rapidly, the report says further, basing this observation on the report of the road's engineer of tests. The metal of the journal and bearing were found to meet Association of American Railroads specifications.

Coach 1860 was built in 1909 and modernized in 1935, the report adds. It was of conventional all steel, plate-girder, post

(*Continued on next left-hand page*)

New Freight Car Authorizations by War Production Board

Allocated from First Quarter, 1944 Materials

Name of Railroad	No.	Type	Builder
Alton	250	Hopper	American Car & Foundry
	250	Gondola	General American
Atchison, Topeka & Santa Fe	400	Hopper	American Car & Foundry
	50	Caboose	Company Shops
Central of New Jersey	500	Hopper	Pressed Steel Car
Chicago, Burlington & Quincy	400	Hopper	Company Shops
Chicago, Milwaukee, St. Paul & Pacific	100	Hopper	Company Shops
Detroit, Toledo & Ironton	100	Gondola	Greenville Steel Car
Great Northern	300	Box	Company Shops
Gulf, Mobile & Ohio	125	Gondola	American Car & Foundry
Illinois Central	300	Hopper	Company Shops
Lehigh Valley	15	Caboose	Company Shops
New York Central	400	Box	Company Shops
New York, Chicago & St. Louis	300	Box	General American
	50	Gondola	Greenville Steel Car
New York, New Haven & Hartford	100	Flat	Greenville Steel Car
Pere Marquette	100	Gondola	Greenville Steel Car
	100	Flat	Greenville Steel Car
Reading	25	Caboose	Company Shops
	600	Hopper	Company Shops
St. Louis-San Francisco	150	Gondola	Company Shops
Seaboard Air Line	200	Box	Pullman-Standard
	200	Hopper	Pullman-Standard
Terminal R. R. of St. Louis	35	Caboose	Mount Vernon Car
Virginian	400	Hopper	Company Shops
Wabash	100	Box	Company Shops
	12	Caboose	Company Shops
	200	Gondola	Company Shops

Allocated from Second Quarter, 1944 Materials

Central of New Jersey	1,000	Gondola	Bethlehem Steel
Lehigh Valley	300	Hopper	Bethlehem Steel
New York, Chicago & St. Louis	500	Hopper	American Car & Foundry
Reading	600	Hopper	Company Shops
Wabash	255	Box	Company Shops
	50	Gondola	Company Shops

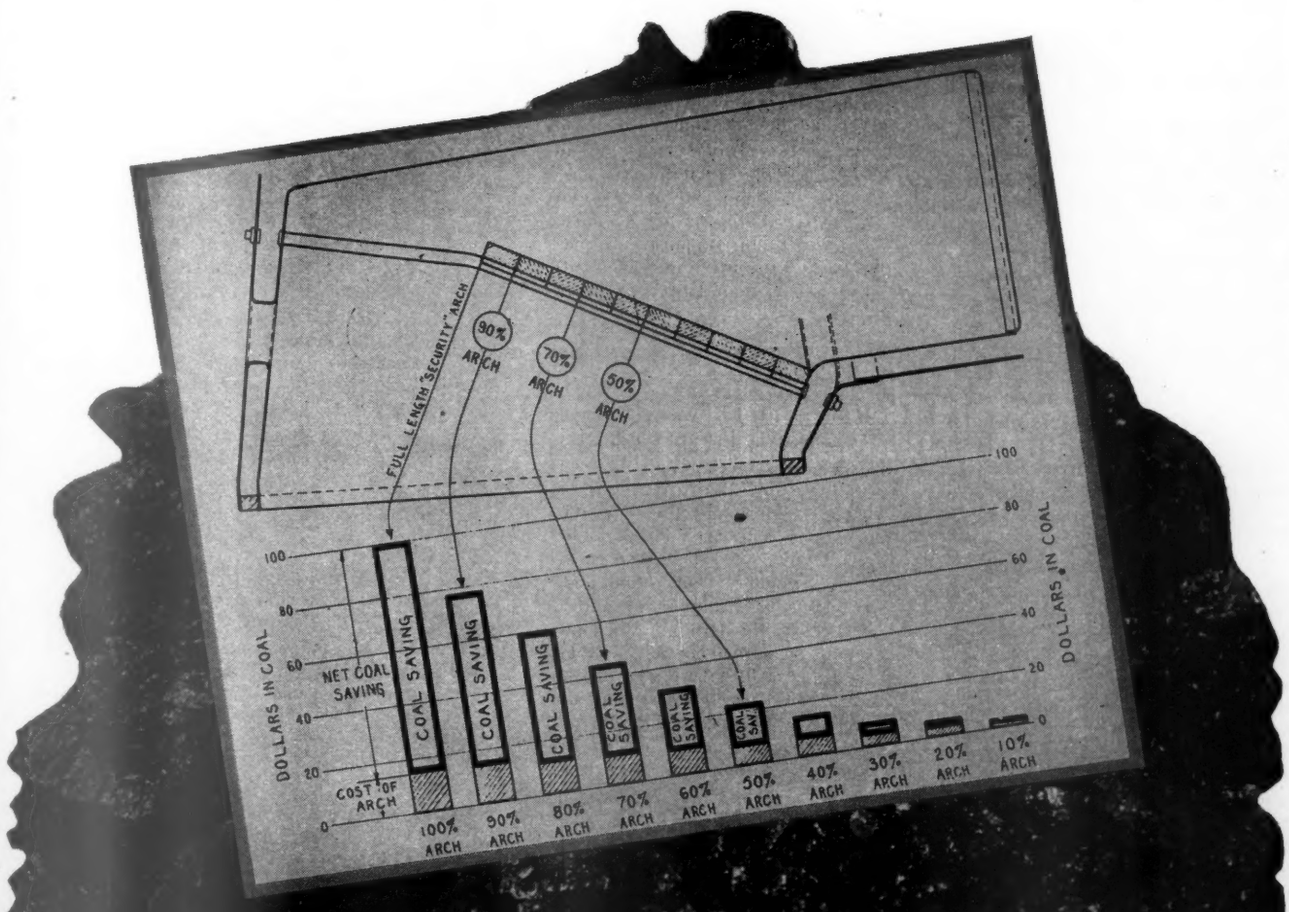
KEEP FUEL-BURNING EFFICIENCY AT A MAXIMUM

Every railroad man is conscious of the wartime importance of each pound of coal.

To make it yield its utmost in steam production is imperative. This is one of the functions of the Security Sectional Arch.

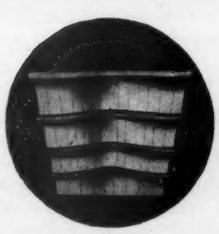
But only a complete arch can achieve the maximum in results. Hence the importance of having full length arches in all locomotives.

This is one sure way of stepping up fuel-burning efficiency.



HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists



AMERICAN ARCH CO.
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Locomotive Combustion Specialists

and sill construction. Class 2B repairs were made in June, 1941. The front wheels of the front truck were mounted on the axle in 1937. The wheels and axle were applied to the car and the journals were repacked June 16, 1943. The car was equipped with four-wheel trucks, with 5½-by 10-in. journals and one-piece cast-steel side frames.

The accident occurred at 6.06 p. m. on the Pennsylvania's four-track main line at a point 150.9 ft. east of a signal tower known as Shore, Pa., which is 2.9 miles east of the North Philadelphia passenger station. In addition to the four main tracks, the line at that point is paralleled on each side by a secondary track. The train was traveling on track No. 1, the eastward passenger track, and the derailment occurred at the west frog of a movable-point crossing where a crossover (from track No. 2 to the southerly secondary track) intersects track No. 1. The rails and ties bore flange marks for about 72 ft. beyond the heel of the west frog of the movable-point crossing, and the track was torn up for 480 ft. and damaged for an additional 1,056 ft. beyond the flange marks.

The train was moving at a speed of 56 m.p.h. in territory where the authorized speed is 70 m.p.h., and had received a proceed indication from the eastward signal at Shore.

Designated as Passenger Extra 4930 East, the train consisted of electric locomotive No. 4930 and 8 coaches, 2 dining cars, and 6 Pullman parlor cars, in the order named. These cars were all of steel construction. The train left Washington, D. C., at 4 p. m. and made no stops in the 2 hr. 6 min. run of 141.4 miles to the point of the accident, as the schedule for the regularly-operated advance section of this train calls for no passenger stops between the initial terminal and Newark, N. J.

The engine and the first six cars, still coupled, stopped with the front end of the engine 2,198 ft. east of the point of the accident. The rear truck of the sixth car became detached and came to a stop on the roadbed adjacent to track No. 1, 740 ft. east of the point of derailment. The seventh to the fourteenth cars, inclusive, and the front truck of the fifteenth car, were derailed. The seventh and eighth cars were demolished and the ninth to twelfth cars, inclusive, were badly damaged. The thirteenth and fourteenth cars were slightly damaged.

Most of the fatalities occurred in the seventh and eighth cars. The seventh car struck the south A-frame supporting the westward signal bridge with sufficient force to shear it from the concrete foundation and move it 22 ft. eastward. The car was sheared for almost its whole length diagonally from the floor on the right side to the junction of the roof and side sheets on the left side, and came to rest with the rear end jammed against the A-frame. The eighth car stopped on its right side on top of the rear end of the seventh car, with the center of its roof against the A-frame. The superstructure was crushed inward and the center sills were bent. The ninth to the twelfth cars came to rest practically upright in various positions across the main tracks. The thirteenth and fourteenth cars remained upright and practically in line with the track. The rear truck of the fifteenth car. and the sixteenth car, remained on the rails.

The commission's investigation developed that members of the crew of the train involved made frequent observations of the equipment between Washington and Shore without observing evidence of an overheated journal. The members of the crews of four eastbound and two westbound freight trains, operators at fifteen points, and mechanical forces at Baltimore, Md., Wilmington, Del., and Philadelphia (Thirtieth Street) and North Philadelphia, also observed the equipment of the train as it passed them and saw no defective condition. The crew of a yard engine standing about 1 mile west of Shore observed fire and smoke from the left side of Passenger Extra 4930 as it was passing. about 1 min. before the accident occurred, and telephoned that fact to the operator at the Shore interlocking tower, but the engine had passed that tower before the operator could take any action to stop the train.

The report disclosed that the mileage accumulated by coach 1860 in a period of 82 days prior to the day of the accident was about 30,000 miles. During this time the car had been used regularly in passenger service between Washington and New York and other points. On the day of the accident it had run from New York to Washington in the train arriving at that terminal about 11:20 a.m., and during that run no defective condition had been observed. During a layover of about 4½ hr. in Washington the journal boxes were supplied with oil and inspected, but no defect was observed.

No recommendation of any change in the road's rules or operating practices is made by the Commission in its report, nor is the accident, even indirectly, attributed to any individual's error or neglect.

Report Shows Low Water Cause of "Century" Accident

THE immediate cause of the explosion of the boiler of the locomotive hauling the eastbound Twentieth Century Limited on the morning of September 7, which derailed that train east of Canastota, N. Y., was overheating of the crown sheet due to low water, according to the report of the Interstate Commerce Commission, issued October 1. In this accident 11 of the 17 streamline passenger-train cars of which the train consisted were derailed. The engineman, fireman, and a traveling fireman were killed, and 9 mail clerks, 5 Pullman porters, a chef, 3 cooks, and 11 dining-car waiters were seriously injured.

The train left Syracuse, N. Y., at 4:13 a. m., 18 min. late, and had proceeded 22 miles to a point 1.4 miles east of Canastota, N. Y., when the boiler exploded at 4:35 a. m. while the train was moving at an estimated speed of 70 miles an hour. (The Valve-Pilot could not be found.) The boiler was torn loose from the running gear, all rivets in the smokebox connection were sheared, and it came to rest 900 ft. forward from the point of the explosion, headed in the opposite direction, nearly upright, and 35 ft. south of the track, which at the scene of the accident is straight and approximately level. Both rails were depressed 2 in. at the point of the explosion. The superheater units remained attached to the header in the smokebox. The running gear and tender, all wheels of which were derailed, came to rest 1,300 ft. from the point of explosion. Parts of the wreckage, including the locomotive cab, the streamline nose, headlight, smokebox door, and the brake valves and pedestal, were scattered in all directions within a radius of 500 ft. The firebox crown sheet, with the upper part of the door sheet and parts of both side sheets attached, was found turned inside out, to the right of the track about 400 ft. forward from the point of the explosion. Many of the appurtenances were broken from the boiler and many parts apparently buried.

The locomotive, No. 5450, was a 4-6-4 type of the J-3a class, which had received a new tender of the tender-bed type, with a capacity of 17,500 gals. of water and 43 tons of coal, on August 18, 1943. At the time of the accident the locomotive had made 17,558 miles since the last shopping. The boiler was equipped with a low-water alarm.

Examination of the boiler following the accident showed that about 19 sq. ft. of the crown sheet had been overheated in a triangular area, the base of which extended between the fourth and fifth longitudinal rows of stays on each side of the center at the front end and tapered irregularly back to the thirtieth transverse row from the flue sheet. The line of demarcation of this area, which was of a distinct blue color, showed the water level to have been about 3½ in. below the highest point of the crown sheet.

On this run the locomotive had hauled train No. 26 from Chicago with changes of crew at Elkhart, Ind.; Toledo, Ohio; Collinwood; Buffalo, N. Y., and Syracuse. The evidence brought out in the investigation, conducted by the Bureau of Locomotive Inspection, Interstate Commerce Commission, disclosed no unusual circumstances until after the train had departed from Buffalo. While operating at reduced speed on yellow block signals between Buffalo and Depew, N. Y., the fireman reported that the extension operating rod which controlled the throttle of the centrifugal feedwater pump became disconnected. The locomotive was operated to Rochester, N. Y., using the injector to supplement the feedwater pump. While standing at a red block signal at Rochester the extension rod was again connected. After leaving Rochester the rod again became disconnected, but this time the throttle was open wide enough so that the pump supplied the boiler without assistance from the injector. A further attempt was made to repair the connection between the extension rod and the valve stem at the Waynesport coaling plant, but the connection again separated shortly after leaving that point. The fireman,

(Continued on next left-hand page)

LOCOMOTIVE BOILERS

"The sustained hauling capacity of a steam locomotive depends primarily on the ability of the boiler to provide the necessary steam . . ."

—THE RAILWAY GAZETTE

• • •

Ample boiler capacity results in low boiler maintenance.

Maximum boiler capacity for any given locomotive is obtained with the small-flue type and Elesco superheater.

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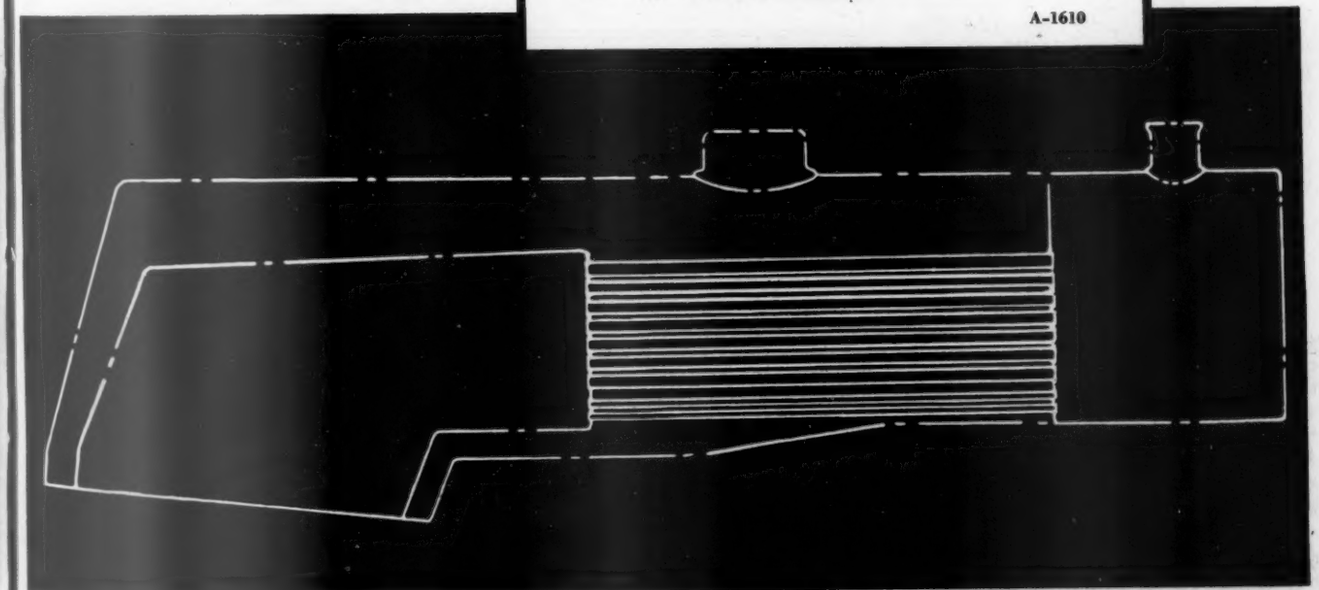

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however, opened the pump throttle to a point wide enough to over-supply the boiler and the water supply was controlled by stopping and restarting the pump with the over-speed trip mechanism. At Syracuse the situation was explained to the engineman, fireman, and traveling fireman who were to take the train east from Syracuse by the engineman, fireman and traveling fireman who brought the train in from Buffalo. These men decided to go on with the locomotive, leaving the relief locomotive which had been called for by the incoming engineman en route.

In discussing the evidence the report points out that "the positions of the injector steam valve, the feedwater pump throttle or operating valve, the feedwater pump reset device at the time of the explosion could not be determined because of the ensuing damage. All persons on the locomotive were killed and, therefore, no information as to the maintenance of the water level after the locomotive departed from Syracuse could be obtained. Judging by the results of boiler explosions investigated by our Bureau of Locomotive Inspection where crown sheets were equipped with protective devices, the effects of the accidents were slight as compared with the complete destruction of the boiler as occurred here. It is obvious that this explosion would not have been so violent if the locomotive had been so equipped." The report concludes with the recommendation "that the New York Central provide crown-sheet protection in case of low water by installing suitable devices for that purpose."

White Heads WPB Equipment Division

LYNNE L. WHITE, chief operating officer of the Chicago & North Western, has been appointed director of the Transportation Equipment Division, War Production Board, succeeding Andrew Stevenson, who has been made executive assistant to Hiland G. Batcheller, the WPB's operations vice-chairman.

Next Six Months Critical, Says Eastman

IN a report "on the state of the nation, so far as railroad transportation is concerned," Joseph B. Eastman, director of the Office of Defense Transportation, in an address October 6 before the New England Shippers Advisory Board at Boston, Mass., warned that, for several reasons, "the next six months will be a critical period in railroad performance."

Saying that he believed that the railroads, with the help of their customers and employees, will be able to maintain their record of superlative performance until they are "over the hump," Mr. Eastman appealed to his listeners to give the "few ounces of help in reserve" that should put the carriers "over the top" in this critical period immediately ahead.

Among the reasons that the immediate future is so critical, according to the ODT director, are: Equipment shortages, growing pressure on the roads that serve the Pacific coast, the advent of winter, diminishing aid from trucks and buses, manpower shortages, featherbed rules, and the effect of recent accidents.

A. S. M. E. Annual Meeting

A HEAVY program is scheduled for the annual meeting of the American Society of Mechanical Engineers to be held at the Hotel Pennsylvania, New York, November 29 to December 2, inclusive. The Railroad Division will hold two sessions on Thursday, December 2, and will also participate in a session with the Oil and Gas Power Division and the Land Transportation Committee of the American Institute of Electrical Engineers on Wednesday afternoon, December 1. The program for these and other sessions of general interest are as follows:

TUESDAY, NOVEMBER 30
9:30 a. m.

Metal Cutting Research (I)

Elements to be Considered in Milling Steel with Cemented Carbide-Tipped Milling Cutters, by Fred W. Lucht, development engineer, The Carboloy Company.

Standardization of Tool Life for Evaluating the Machinability of Single Point Tools, Cutting Fluids, or Materials Cut, by O. W. Boston, University of Michigan.

2 p. m.

Chip Control

Symposium:

Increasing Tool Life by Better Tool Finishing, by V. H. Ericson, The Norton Company.

Chip Control with Sintered Carbide Tools, by M. F. Judkins, Firthite Division, Firth-Sterling Steel Company.

Standardization of Chip-Breaker Type of Fine-Finished Single-Point Cutting Tools, by Carl J. Wiberg, production engineering department, Wright Aeronautical Corporation.

The Practical Aspects of Chip Control, by Frank J. Oliver, The Iron Age.

New Principles in the Design, Generation, and Maintenance of Cutting Tools, with a demonstration of the Bura-way grinder for grinding single-point tools, by Walter M. Bura, The James Donaldson Co., Inc.

Metal Cutting Research (II)

Practical Cutting Fluid Recommendations for Use with High-Speed-Steel Tools, by O. W. Boston, University of Michigan; H. L. Moir, Pure Oil Company; E. M. Slaughter, Republic Steel Company, and W. H. Oldacre, D. A. Stuart & Company.

Metal-Cutting Nomograph for Cutting Steel with Single-Point Tools, by W. W. Gilbert and W. C. Truckenmiller, University of Michigan.

WEDNESDAY, DECEMBER 1
2 p. m.

Oil and Gas-Power—Railroad—Land Transportation Committee, A. I. E. E.

Factors Involved in the Selection of Railroad Motive Power, by Brig. Gen. C. D. Young, deputy director, Office of Defense Transportation.

7 p. m.

Annual dinner.

THURSDAY, DECEMBER 2
9:30 a. m.

Plastics

Creep Properties of Molded Phenolic Plastics, by David Telfair, T. S. Carswell, and H. K. Nason, Plastics Division, Monsanto Chemical Company.

Plastic Printing Plates, by William R. McLain.

Anti-scatter Treatments for Glass, by Frank W. Reinhart, Ruth Kronstadt, and Gordon M. Kline, National Bureau of Standards.

Railroad (I)

Possibilities of New Materials To Be Used in Railroad Equipment in the Postwar Period, by C. B. Bryant, engineer of tests, Southern Railway.

Passenger Cars for the Postwar Period, by Edward G. Budd, Edward G. Budd Manufacturing Company.

Report of the Committee on Survey, RR-6, by E. G. Young, professor, railway mechanical engineering, University of Illinois.

Report of the Standing Technical Committee—Locomotives, by Lawford H. Fry, director of research, Locomotive Institute.

Report of the Standing Technical Committee—Cars, by K. F. Nystrom, mechanical assistant to vice-president, Chicago, Milwaukee, St. Paul & Pacific.

12:30 p. m.

Railroad Luncheon.

2 p. m.

Railroad (II)

Research Possibilities in Railroad Equipment, by W. I. Cantley, mechanical engineer, Association of American Railroads.

Education of Railway Mechanical Engineers for the Postwar Period, by Roy V. Wright, editor, *Railway Mechanical Engineer.*

Orders and Inquiries for New Equipment Placed Since the Closing of the October Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Southern Pacific	19	1,000 hp. Diesel-elec.	Baldwin Loco. Works

LOCOMOTIVE INQUIRIES

Tennessee Central	4	2-8-4 or 2-8-2	

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Baltimore & Ohio	1,000[1]	50-ton composite hopper	Bethlehem Steel Co.
Bethlehem Steel Co.	100	50-ton gondola	Co. shops
Central of New Jersey	1,000	70-ton composite gondola	Bethlehem Steel Co.
	500	50-ton composite hopper	Pressed Steel Car Co.
	100	70-ton flat	Pressed Steel Car Co.
Chicago, Burlington & Quincy	170	Box[2]	Co. shops
	175	Automobile[2]	Co. shops
Delaware & Hudson	100	50-ton all-steel gondola	Bethlehem Steel Co.
	100	50-ton all-steel hopper	Bethlehem Steel Co.
New York, New Haven & Hartford	100[3]	70-ton flat	Greenville Steel Car Co.
St. Louis-South Western	150[3]	150 gondola	Co. shops
Southern Pacific	200[4]	50-ton gondola	Pressed Steel Car Co.
	300[4]	50-ton gondola	Mt. Vernon Car Mfg.

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Grand Trunk Western	300	70-ton gondola	.....
Missouri Pacific Lines:			
Missouri Pacific	500[5]	70-ton hopper	.....
N. O. T. & M.	200[5]	70-ton hopper	.....
Int. Grt. Nor.	100[5]	40-ton stock	.....

[1] Subject to WPB approval.

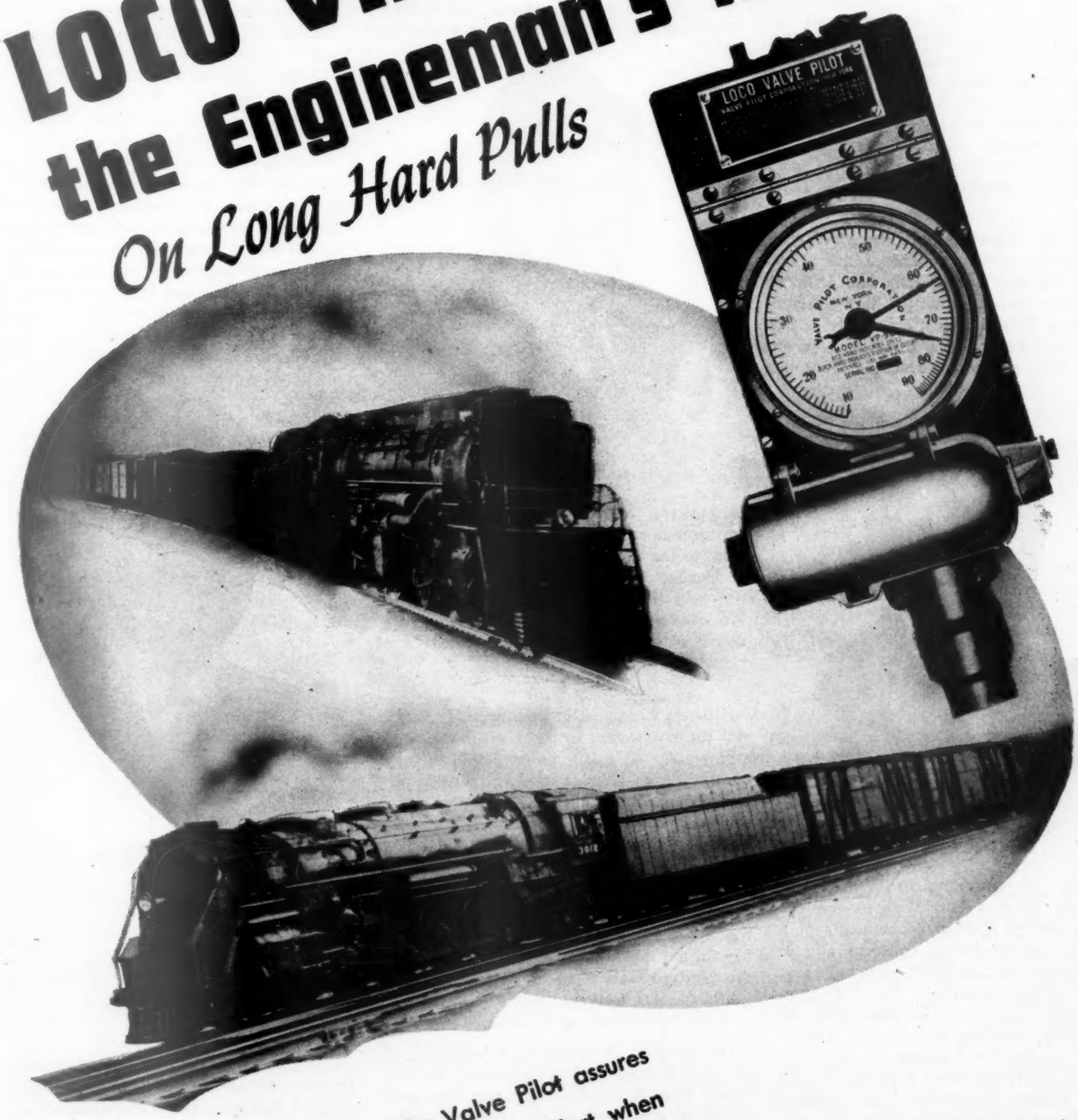
[2] Unconfirmed.

[3] Unconfirmed; subject to WPB approval.

[4] Total cost of 500 cars $1,760,000. Deliveries scheduled for second and third quarters of 1944.

[5] Federal court authorization for the purchase of these cars, at total estimated cost of $2,729,000, was received on September 21.

LOCO VALVE PILOT
the Engineman's friend
On Long Hard Pulls



Accurate and positive, the Valve Pilot assures the engineman of maximum tractive effort when needed and provides for him and the management a written record of fine performance.

VALVE PILOT CORPORATION

230 Park Avenue, New York 17, N. Y.

Supply Trade Notes

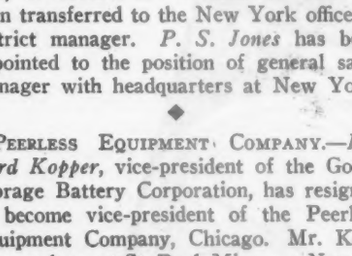
AMERICAN STEEL & WIRE CO.—*E. A. Murray,* supervisor of the Priorities division of the Cleveland general sales office of the American Steel & Wire Co., has been appointed assistant manager of the manufacturers' sales department in the Chicago sales office of this company.

◆

CUTLER-HAMMER, INC.—*C. V. Topliffee* has been appointed manager of the Boston, Mass., district office of Cutler-Hammer, Inc., to succeed *W. E. Addicks* who has been transferred to the New York office as district manager. *P. S. Jones* has been appointed to the position of general sales manager with headquarters at New York.

◆

PEERLESS EQUIPMENT COMPANY.—*Edward Kopper,* vice-president of the Gould Storage Battery Corporation, has resigned to become vice-president of the Peerless Equipment Company, Chicago. Mr. Kopper was born at St. Paul, Minn., on November 27, 1890, and was graduated from the



Edward Kopper

University of Minnesota in 1913. After graduation, he was employed in the engineering and production departments of a number of manufacturing concerns and in 1919 was appointed assistant superintendent of shops of the American Hoist & Derrick Co., St. Paul. Later he established his own business, handling the sales of railway and mill supplies for a number of manufacturers. In 1931, he went with the Gould Storage Battery Corporation as railway sales manager and later was elected vice-president.

William E. Gray, formerly engineer of draft gear tests at the Purdue engineering experiment station, has been elected vice-president in charge of engineering of the Peerless Equipment Company. Mr. Gray was born on October 6, 1896, in Coupon, Pa., and for several years was employed in the engineering department of the Pittsburgh Meter Company. He served on the Mexican border with the 107th Field Artillery of the Pennsylvania National Guard and in World War I. After the war he attended Purdue University, of which he was a graduate in 1923. He then entered the employ of the steam generation department of the Semet-Solvay Company at Ashland, Ky., and in February, 1924, was appointed instructor of mechanical engineering at Purdue University. In November, 1926, Mr. Gray was placed in charge of draft-gear investigations on part time and

William E. Gray

in January, 1927, he resigned as instructor of mechanical engineering to devote full time to the draft-gear investigation. While at Purdue, he was engaged in field work at different times on various projects for the Association of American Railroads and also acted as consultant for manufacturers of railway mechanical equipment.

◆

PHILCO CORPORATION.—*Lionel M. Searle,* for the past year manager of the Monroe street plant of the Simplex Radio division of the Philco Corporation, Sandusky, O., has been appointed manager of the entire division.

◆

ALLEGHENY-LUDLUM STEEL CORPORATION.—*Paul E. Floyd,* who has been on leave of absence in the iron and steel branch of the War Production Board, has resumed his former position as district manager in the Chicago branch office of the Allegheny-Ludlum Steel Corporation.

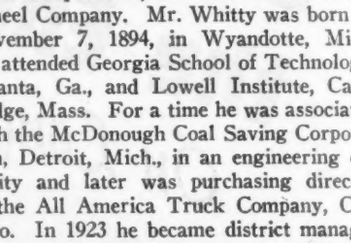
◆

OLIVER IRON & STEEL COMPANY.—*J. G. Graham,* manager of railway sales for the Oliver Iron & Steel Corporation, has been appointed a member of the rails and accessories industry advisory committee of the War Production Board.

◆

REYNOLDS METAL COMPANY.—*G. S. Goodwin,* who retired after 37 years' service in the mechanical department of the Chicago, Rock Island & Pacific, as announced in the October issue, has become associated with the Reynolds Metals Company, Railway Supply division, Chicago, where he will have charge of designing new car equipment and parts for modernizing locomotives and cars.

BALDWIN LOCOMOTIVE WORKS. — The Baldwin Locomotive Works, Philadelphia, Pa., has opened a new district office at 10 High Street, Boston, Mass., under the managership of *Wilbur H. Whitty.* Mr. Whitty will direct sales in the New England area for all divisions of the company, including the Locomotive and Ordnance Division, Baldwin-Southwark Division, Cramp Brass and Iron Foundries Division, Standard Steel Works Division, Baldwin de La Vergne Sales Corporation, and the Pelton Water Wheel Company. Mr. Whitty was born on November 7, 1894, in Wyandotte, Mich. He attended Georgia School of Technology, Atlanta, Ga., and Lowell Institute, Cambridge, Mass. For a time he was associated with the McDonough Coal Saving Corporation, Detroit, Mich., in an engineering capacity and later was purchasing director of the All America Truck Company, Chicago. In 1923 he became district manager of the Riley Stoker Corporation, Worcester, Mass., and in 1929 founded the Whitty



Wilbur H. Whitty

Manufacturing Company, Inc., Boston, manufacturers of automatic stokers. He was president of the latter company until January, 1942, when he resigned to join the War Production Board as head industrial specialist for New England.

◆

TIMKEN ROLLER BEARING COMPANY.—*Whitley B. Moore,* general manager of sales of the Steel and Tube division of the Timken Roller Bearing Company, Canton, Ohio, has been appointed director of sales of all divisions and has been succeeded by *C. H. McCollam,* assistant general manager of sales of the Steel and Tube division.

Whitley B. Moore, was a graduate of the University of Michigan in 1918 with a degree in mechanical engineering. He served in the Navy during the last war and immediately after the war went with the Timken Company where he worked in the shop engineering department. In 1921 he was sent to the West Coast as Western

(*Continued on next right-hand page*).

division manager; in 1924 he returned to Canton as assistant general manager of the Industrial division, a new department, and in 1934 he became general manager of that division in full charge of all industrial sales. He became general manager of sales, Steel and Tube division, in 1940.

C. H. McCollam was born in Canton and for a few years was employed in the chemical research department of the General Electric Company. He went with Timken in 1918 as a control analyst in the chemical and metallurgical laboratories of the company and in 1925 he became chief chemist. Since 1940 he has been assistant general sales manager of the Steel and Tube division.

◆

GENERAL ELECTRIC COMPANY.—*B. F. Ilsley* has been appointed assistant manager of sales at the newly-formed Oakland, Calif., works section of the General Electric Company's wire and cable division. He was formerly assistant to the manager of the wire and cable division. *J. S. Overstreet,* who has been in charge of wire and cable sales of the company's commercial cable division, has been appointed assistant manager of sales for the cable section at Schenectady, N. Y., and *J. J. Curtin,* of the wire and cable division at Fort Wayne, Ind., has been appointed assistant manager of sales for the magnet wire section in that city.

◆

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.—*Gwilym A. Price,* president of the Peoples-Pittsburgh Trust Company, Pittsburgh, Pa., has been elected a vice president of the Westinghouse Electric & Manufacturing Co.

Thomas I. Phillips, vice-president, has been appointed head of the company's Pittsburgh, Pa., divisions to succeed *A. C. Streamer,* who has been appointed assistant to the president. Mr. Phillips began his career with Westinghouse in 1915 as a tool maker.

◆

WHITING CORPORATION.—*A. J. Brown* has been appointed manager of the Pacific coast branch of the Whiting Corporation, Harvey, Ill., with headquarters in Los Angeles, Calif. Mr. Brown has been an executive of the Whiting Corporation for the past 14 years. Prior thereto he was associated with the Allis-Chalmers Manufacturing Company for 28 years.

◆

SYMINGTON-GOULD CORPORATION.—*W. J. Phillips,* formerly assistant general manager of the Rochester, N. Y., plant of the Symington-Gould Corporation, has been transferred to the company's miscellaneous steel castings sales division in New York.

◆

PEERLESS EQUIPMENT COMPANY.—The Peerless Equipment Company, of Chicago, now represents the *Gould Storage Battery Corporation,* of Depew, N. Y., in the sale of railroad, car-lighting and air-conditioning batteries to all railroads having headquarters in Chicago and the Twin City area. Peerless will also represent the Gould Company in the sale of signal batteries and equipment with northwestern roads. The *Modern Supply Company,* of Chicago, will continue to represent Gould in the sale of signal batteries and equipment with all railroads having headquarters in the Chicago area. *Edward Kopper,* of the Chicago office of the Gould Storage Battery Corporation, and *Harry Matthews,* also associated with Gould in the sale of railroad batteries, have joined the Peerless Equipment Company.

◆

AMERICAN BRAKE SHOE COMPANY.—*M. N. Trainer* has been elected first vice-president of the American Brake Shoe Company. Mr. Trainer has been a vice-president of the American Brake Shoe

M. N. Trainer

Company since 1933, and president of the Brake Shoe and Castings Division since 1939, of which division he will continue as president. Mr. Trainer, a graduate of the University of Pennsylvania in 1910, joined the American Brake Shoe Company in 1916 as a brake-shoe inspector. He went into sales and sales engineering, and in 1926 became vice-president of American Malleables Company and also of American Brake Materials Company. In this latter position Mr. Trainer devoted his attention to the development of brake materials for the automotive industry. After completing this assignment he returned to the sales, production, and improvement of railroad brake shoes.

◆

GLOBE STEEL TUBES COMPANY.—*Thomas R. Coffey* has been appointed manager of sales, Wisconsin-Minnesota district, of the Globe Steel Tubes Company. Mr. Coffey's headquarters are at Milwaukee, Wis.

◆

BIRD-ARCHER COMPANY, LIMITED.—*Hugh C. Harragin,* formerly vice-president and general manager, has been elected president and general manager of the Bird-Archer Company, Limited, Montreal, Que.

◆

COLUMBIA STEEL COMPANY.—*F. B. DeLong,* vice-president in charge of sales in the Los Angeles, Calif., district for the Columbia Steel Company, west coast subsidiary of the United States Steel Corporation, has been appointed vice-president and general manager of sales for the company, to succeed *J. R. Gregory.* Mr. DeLong began his career with the Columbia Steel Company in 1937 as manager of the tubular alloy and stainless department in Los Angeles. He was appointed district manager of sales of the Los Angeles district a few months later and elected vice-president in charge of sales in December, 1939.

◆

GRAYBAR ELECTRIC COMPANY.—*Norman M. White,* service manager at St. Louis, Mo., has been appointed district operating manager at Dallas, Tex., for the Graybar Electric Company. *J. R. Ernest,* assistant to the general service manager, has been appointed district operating manager at St. Louis, and will assume the duties formerly performed by Mr. White. Mr. White joined the Philadelphia, Pa., office of the Graybar Electric Company in 1922 as a stockman. He was appointed service supervisor at Baltimore, Md., in 1926, and service manager at St. Louis in 1940. Mr. Ernest joined the Graybar Company at Chicago in 1924. He was transferred to the company's headquarters as sales statistician in 1940, and later became assistant to the general service manager.

◆

LODGE & SHIPLEY MACHINE TOOL COMPANY.—The Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, is planning to convert its plant facilities to the production of Diesel engine parts, aircraft propeller parts and other new types of products as soon as its present backlog of lathe orders is reduced. The work will be carried out under sub-contract for the General Machinery Corporation, Hamilton, Ohio, and the Aero Products Corporation division of the General Motors Corp.

◆

BEATTY MACHINE & MANUFACTURING COMPANY.—*L. C. Beatty,* president of the Beatty Machine & Manufacturing Company, succeeds his father, William R. Beatty, deceased, in the management of that company. L. C. Beatty came with the company after his graduation from Purdue University in 1931.

◆

GRIP NUT COMPANY.—*Ernest H. Weigman* has resigned as vice-president in charge of sales of the Grip Nut Company, Chicago, to establish his own business. *John D. Ristine,* assistant to the president, will handle the sales department of Grip Nut in addition to his other duties.

◆

WINE RAILWAY APPLIANCE COMPANY.—*William F. Cremean,* who has been associated with the Wine Railway Appliance Company for 25 years, has been relieved of his duties as works manager but will continue with the company in a consulting capacity. *N. E. Weiffenbach,* formerly supervisor of the car department for the Wheeling & Lake Erie, has joined the engineering department of the company.

Obituary

WILLIAM R. BEATTY, of the Beatty Machine & Manufacturing Company, Hammound, Ind., died on September 8 at his

(*Continued on second left-hand page*)

GM DIESEL LOCOMOTIVES REQUIRES ONLY SIMPLE MAINTENANCE FAC

SOUTHERN RAILWAY
DIESEL MAINTENANCE SHOP
LUDLOW, KY.

OIL AND AIR FILTER CLEANER WITH DRYING OVENS.

MAIN STOREROOM.

GENERAL MOTORS
LOCOMOTIVES

DESIGN
FACILITIES...

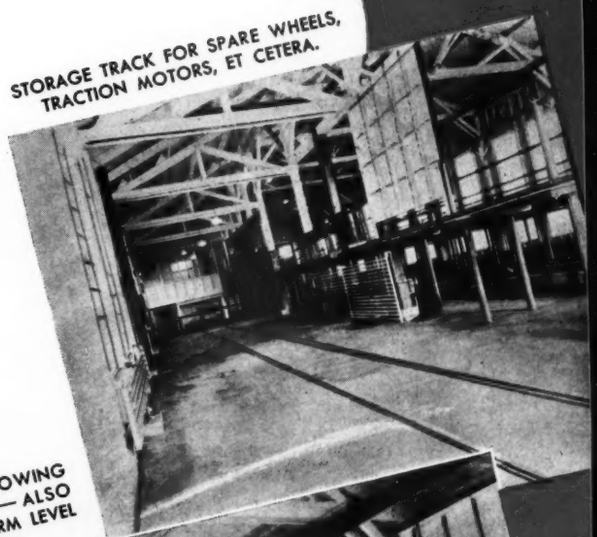
THE philosophy back of Electro-Motive basic design was, and still is, simplicity of construction, ease of operation and maintenance, interchangeability of standardized parts completely finished and ready for application.

The success of this thinking is best evidenced by the outstanding performance of some 1200 General Motors Diesel Locomotive Units, now operating in all classes of service.

The adequate and efficient, yet inexpensive, maintenance facilities of the Southern Railway at Ludlow, Kentucky, here illustrated, are typical of the present trend of railroads using GM Diesel Locomotives.

★ **KEEP AMERICA STRONG—**
BUY MORE WAR BONDS ★

STORAGE TRACK FOR SPARE WHEELS, TRACTION MOTORS, ET CETERA.



RUNNING MAINTENANCE SHOP SHOWING FILTER CLEANING EQUIPMENT — ALSO STOREROOM ON WORK PLATFORM LEVEL SHOWN AT EXTREME RIGHT.

RUNNING MAINTENANCE SHOP SHOWING DEPRESSED FLOOR AND ELEVATED WORK PLATFORM.

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS CORPORATION LA GRANGE, ILLINOIS, U.S.A.

home near Hammond, Ind. Mr. Beatty was active until shortly before his death, in the management of the Beatty Machine and Manufacturing Company, which concern he founded 26 years ago. He was 66 years old. As a young man he worked with an iron and steel concern in Pittsburgh, Pa., and later as general superintendent of the New Castle Forge and Bolt Company, at New Castle, Pa. Later he was Chicago sales manager for the Williams-White Company, of Moline, Ill. In 1917 he organized his own business, manufacturing heavy metal working tools.

◆

GEORGE T. LADD, chairman of the board of the Woodings Forge & Tool Co., and the Woodings-Verona Tool Works, and president of the United Engineering & Foundry Co., died on October 3, at Pittsburgh, Pa., after an extended illness.

◆

G. L. L. DAVIS, vice-president in charge of sales of the Scullin Steel Company, died October 5. He was 67 years of age. Mr. Davis had been associated with the Scullin Steel Company since 1910.

◆

ALBION JAMES WADHAMS, a vice-president and manager of the development and research division of the International Nickel Company, Inc., in New York, died August 22. He was 68 years old.

◆

CHARLES ROSS DAVISON, mechanical engineer of the Standard Stoker Company, Inc., died suddenly on September 20, of a heart attack, at his home in Erie, Pennsylvania. Mr. Davison was born in Butler County, Pennsylvania, August 3, 1883. After early schooling he attended Westminster College and later Bradley Polytechnic Institute where he received his degree in mechanical engineering. He spent 10 years teaching in Pittsburgh public schools and entered the Locomotive Stoker Company in July, 1917. He joined The Standard Stoker Company, Inc., in February, 1928, serving as chief draftsman until 1936 when he was advanced to the position of mechanical engineer. Mr. Davison was a member of the American Society of Mechanical Engineers and held numerous patents on locomotive stokers.

C. R. Davison

◆

L. G. CALDER, president of the Bird-Archer Company, Limited, Montreal, Que., died June 14. Mr. Calder had been associated with the company since 1929, when he was elected vice-president and general manager. He became president in 1932.

◆

W. E. HEDGCOCK, vice-president in charge of sales of the American Car and Foundry Company, New York, died on October 26.

◆

P. V. HICKEY, vice-president of the Pantasote Company, Inc., New York, died on October 14.

Personal Mention

General

PETER ROBERT BROADLEY, chief marine engineer of the Central of New Jersey at Jersey City, N. J., has been appointed mechanical engineer, with headquarters at Elizabethport, N. J., succeeding G. W. Rink, who has resigned from that position. Mr. Broadley was born on March 6, 1908, at Alloa, Scotland. He was a graduate of the Newark College of Engineering in 1932, and a student at the Graduate School of Stevens Institute of Technology. Mr. Broadley entered railroad service on July 20, 1923, as a blueprinter in the employ of the Central of New Jersey at Elizabethport. On November 3, 1924, he was appointed special apprentice and on September 9, 1926, draftsman at Elizabethport. On December 10, 1928, he left the employ of the Central of New Jersey to become draftsman, shop production, rail-car and locomotive division, of International Mack Motors at Plainfield, N. J. He returned to the Central of New Jersey as draftsman at Elizabethport on August 5, 1930. On November 1, 1935, he was appointed mechanical inspector, and on April 1, 1940, chief marine engineer at Jersey City.

P. R. Broadley

JOHN J. MILLER has been appointed chief electrical supervisor, Montreal (Que.) terminals, Canadian National.

R. V. BLOCKER, superintendent of motive power of the Erie at Cleveland, Ohio, has resigned.

HAROLD W. WREFORD has been appointed electrical supervisor, Montreal (Que.) terminals, Canadian National.

W. A. CARLSON, western district master mechanic of the Erie at Meadville, Pa., has been appointed assistant superintendent of motive power, with headquarters at Cleveland, Ohio.

O. J. PROTZ, superintendent of locomotive and car shops of the Chicago & North Western, has been appointed superintendent of motive power, Northern district, with headquarters as before at Chicago.

N. R. CRUMP, assistant to the vice-president of the Canadian Pacific, with headquarters at Montreal, Que., has been appointed general superintendent, Ontario district, of that road, with headquarters at Toronto, Ont.

WILLIAM MOORE, assistant superintendent of motive power of the Erie, has been appointed superintendent of motive power, with headquarters as before at Cleveland, Ohio.

THOMAS F. POWERS, superintendent of motive power of the Northern district of the Chicago & North Western, has been appointed chief mechanical officer, with headquarters as before at Chicago.

ALBERT EDWARD COLEMAN, electrical superintendent of the St. Clair Tunnel at Port Huron, Mich., has been appointed to the newly created position of assistant superintendent of motive power of the Canadian National, Montreal terminals, Que.

R. W. KELLER, supervisor of the Central of New Jersey in charge of all electrical matters at Jersey City, N. J., has been appointed electrical engineer with headquarters at Jersey City.

R. H. BEVERLEY, assistant engineer of tests of the Southern, has been appointed engineer of tests, with headquarters at Alexandria, Va. Mr. Beverley was born in Fauquier County, Va., and is a graduate of Virginia Polytechnic Institute (1900). He entered railroad service in 1901 as an inspector. He was subsequently appointed chief inspector and assistant engineer of tests.

J. E. GOODWIN, mechanical superintendent of the Southern district of the Missouri Pacific at St. Louis, Mo., has been appointed to fill the newly created position of assistant chief mechanical officer, system, of the Chicago & North Western, with headquarters at Chicago.

CHARLES B. BRYANT, engineer of tests of the Southern, has been appointed to the newly created position of assistant to the vice-president, in charge of research and tests, with headquarters at Washington, D. C.

S. O. RENTSCHLER, superintendent of shops of the Missouri Pacific at Sedalia, Mo., has been appointed to mechanical superintendent of the Southern district, with headquarters at St. Louis, Mo.

A. MALMGREN, road foreman of equipment of the St. Louis-San Francisco at Springfield, Mo., has been appointed assistant superintendent of the Southern division, with headquarters at Thayer, Mo.

H. H. THOMAS, assistant master mechanic of the Iowa and Northern Iowa divisions of the Chicago & North Western at Clinton, Iowa, has been appointed superintendent of locomotive and car shops, with headquarters at Chicago.

B. V. JOHNSON, supervisor of repairs, Diesel and motor car service and maintenance of the Union Pacific at Los Angeles, Calif., has been appointed superintendent of Diesel and motor car service and maintenance of the system, with headquarters at Omaha, Neb.

ERIC WYNNE, who has been appointed mechanical engineer, shop methods, of the Canadian National, with headquarters at Montreal, Que., as noted in the September issue, was born at Stafford, England, and came to Canada as a young boy. He entered the employ of the Grand Trunk Pacific (now Canadian National) as a call boy in the mechanical department at Melville, Sask. He subsequently served as a machinist apprentice, and in March, 1921,

Eric Wynne

became a machinist at Edmonton, Alta. After serving in that capacity and as acting foreman, legerwood operator and locomotive foreman at McBride, B. C., Mr. Wynne was transferred to the Fort Rouge shops at Winnipeg, Man., and in June, 1936, was appointed engine inspector. On February 1, 1942, he became supervisor of special work, and on January 16, 1943, mechanical inspector for the System, with headquarters at Montreal.

J. J. THOMPSON, mechanical assistant to the president of the Tennessee Central, has been appointed assistant general manager, with headquarters as before at Nashville, Tenn.

LEWIS S. BILLAU, assistant electrical engineer of the Baltimore & Ohio, has been promoted to the position of electrical engineer, with headquarters at Baltimore, Md.

Master Mechanics and Road Foremen

ELMER HOLMQUIST, master mechanic of the Wisconsin and Madison divisions of the Chicago & North Western, has retired.

J. WALKER has been appointed assistant master mechanic of the Missouri Pacific, with headquarters at Wichita, Kan.

F. D. DUNTON has been appointed master mechanic of the Erie, with headquarters at Avoca, Pa.

H. T. CARTER has been appointed road foreman of engines of the Southern, Eastern lines, with headquarters at Alexandria, Va.

H. I. PHELPS, master mechanic of the Erie at Avoca, Pa., has been transferred to the position of master mechanic at Secaucus, N. J.

E. BRANNING, master mechanic of the Erie at Secaucus, N. J., has been transferred to the position of division master mechanic at Hornell, N. Y.

EDWARD POOL, division master mechanic of the Erie at Hornell, N. Y., has been promoted to district master mechanic, with headquarters at Meadville, Pa.

A. WALKER, assistant master mechanic of the Wichita division of the Missouri Pacific at Wichita, Kan., has been transferred to the position of assistant master mechanic at Kansas City, Mo.

A. O. ELLIOTT has been appointed road foreman of engines of the Southern, Eastern lines, with headquarters at Alexandria, Va.

F. L. BAKER, master mechanic of the Galena division of the Chicago & North Western, has been appointed master mechanic of the Wisconsin and Madison divisions, with headquarters as before at Chicago.

A. H. BAIR has been appointed master mechanic of the Union at East Pittsburgh, Pa., succeeding George Sanders, whose illness prevents his fulfilling the duties of this position.

W. A. LANGLANDS, master mechanic of the Chicago Terminal division of the Chicago & North Western, has had his jurisdiction extended to the Galena division. His headquarters are at Chicago.

C. L. CHRISTY, assistant master mechanic of the Kansas City Terminal division of the Missouri Pacific at Kansas City, Mo., has been appointed master mechanic of the Omaha-Northern Kansas and Kansas City Terminal divisions, with headquarters at Falls City, Neb.

MERCEIL J. BRADY, who has been appointed master mechanic of the Canadian National with headquarters at Calgary, Alta., as announced in the September issue, was born on December 15, 1896, at

M. J. Brady

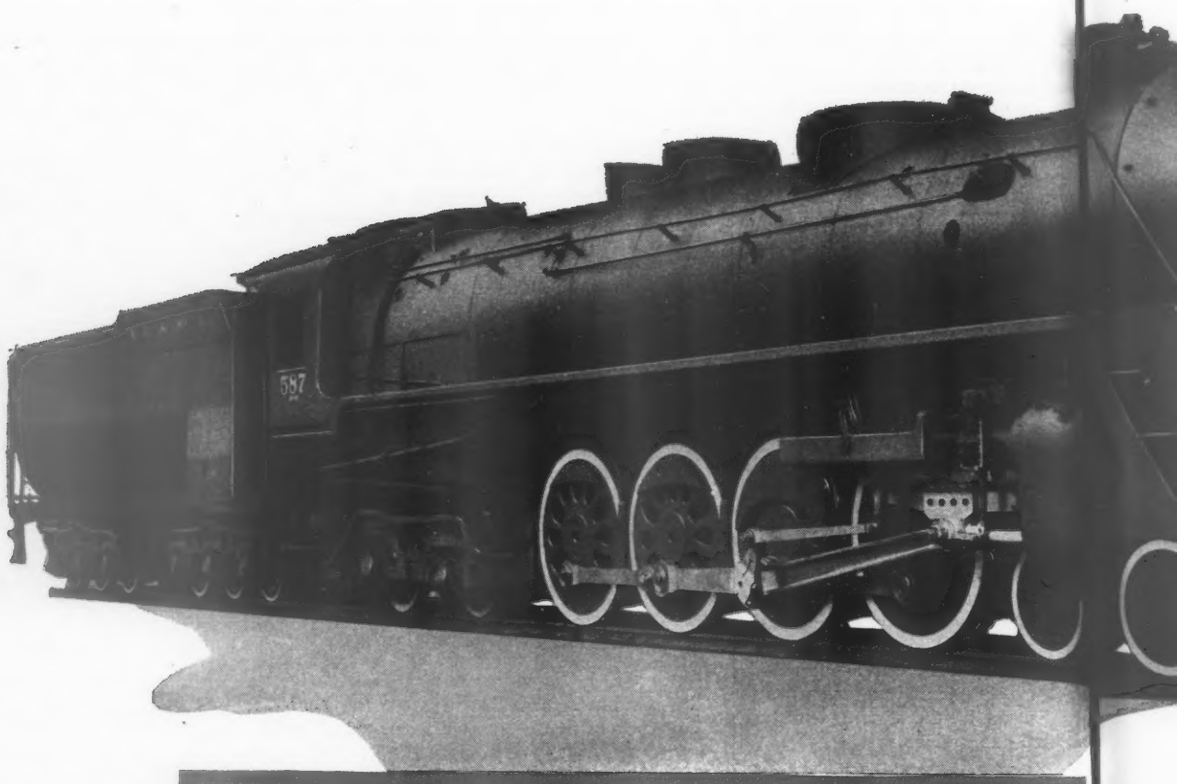
Oswego, N. Y. He entered railroad service in September, 1912, as a machinist apprentice in the employ of the Canadian Pacific, serving at Alyth and Ogden shops, Calgary, until July, 1917, when he transferred to the Canadian National as a machinist at Hanna, Alta. In June, 1936, he became assistant locomotive foreman at Wainwright, Alta.. in April, 1941, locomotive foreman at Kindersley, Sask., and in June, 1943, master mechanic of the Calgary division.

L. H. RABUN, who has been appointed master mechanic of the Chicago, Milwaukee, St. Paul & Pacific at Savanna, Ill., as noted in the August issue, was born on March 1, 1896, in Chattanooga, Hamilton Co., Tenn. He attended grade and high schools and the Southern Commercial

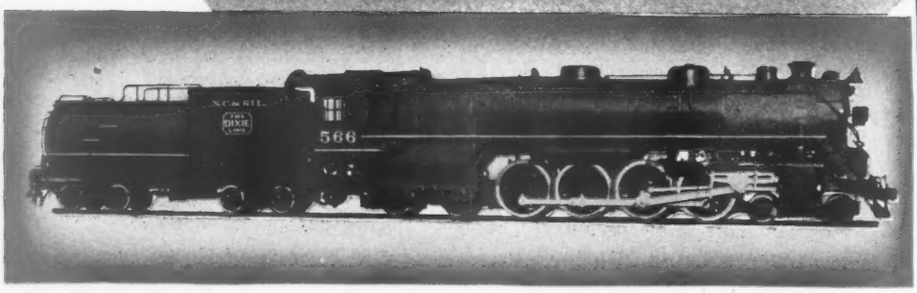
L. H. Rabun

School at Chattanooga, and entered railroad work on September 12, 1912, as a machinist apprentice in the employ of the Cincinnati, New Orleans & Texas Pacific at Chattanooga. From February, 1917, to October, 1922, he was a machinist successively in the employ of the Great Northern, Northern Pacific, Denver & Rio

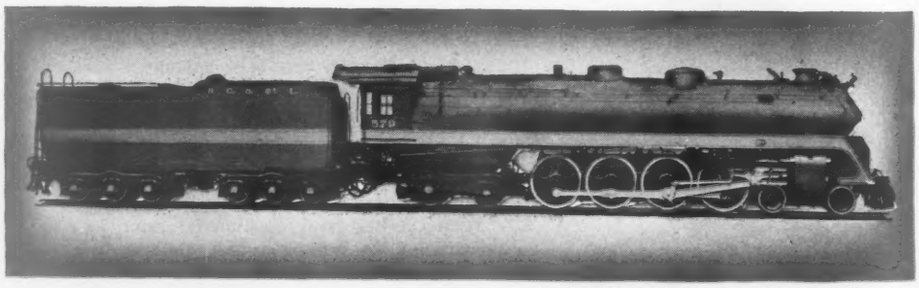
(*Continued on second left-hand page*)



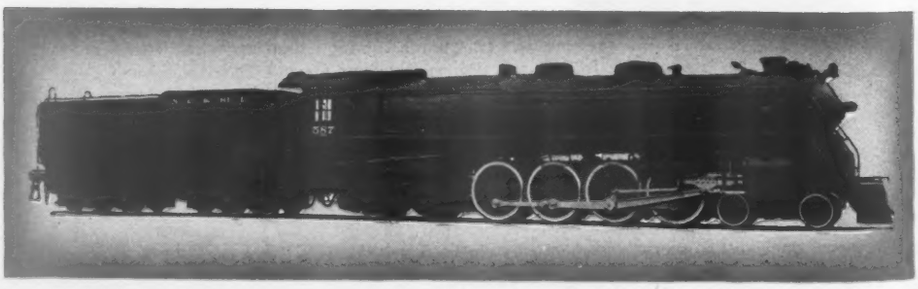
5
Delivered in March
1930



10
Delivered in July
1942



10
Delivered in September
1943



THE DIXIE LINE

The Nashville, Chattanooga and St. Louis Railway placed in service in 1930 five 4-8-4 type Alco locomotives. A steady increase in traffic created a vital need for more motive power. As a result ten improved 4-8-4 type locomotives were delivered to this road by Alco in July, 1942, and only recently, in September, 1943, Alco delivered ten more.

Right now the railroads are handling the heaviest traffic on record. Powerful steam locomotives of proven design are in large measure responsible for this outstanding performance.

Locomotive Characteristics

Weight on Drivers	228,000 Lb.	Boiler Pressure	250 Lb.
Weight of Engine	399,000 Lb.	Tractive Power	57,000 Lb.
Cylinders	25 x 30 Ins.	Tender Capacity, Fuel	16 Tons
Diameter of Drivers	70 Ins.	Tender Capacity, Water	15,000 Gals.

AMERICAN LOCOMOTIVE

MANUFACTURERS OF MOBILE POWER
STEAM, DIESEL AND ELECTRIC LOCOMOTIVES, MARINE DIESELS, TANKS, GUN CARRIAGES & OTHER ORDNANCE

Alco

DEC 16 1943

Grande, Great Western, Missouri Pacific, and the Chicago, Milwaukee, St. Paul & Pacific. He was appointed assistant enginehouse foreman of the latter road at Kansas City, Mo., on October 15, 1922; assistant enginehouse foreman at Davenport, Iowa, on January 15, 1923; assistant enginehouse foreman at Ottumwa, Iowa, on September 1, 1923; assistant foreman at Sioux City, Iowa, in April, 1925; enginehouse foreman at Soo Falls, S. D., in April, 1932; enginehouse foreman at Miles City, Mont., on September 1, 1932; enginehouse foreman at Mobridge, S. D., on December 15, 1932; general foreman at Ottumwa on May 1, 1934; assistant master mechanic of the Chicago Terminals and Terre Haute division on May 1, 1941, and division master mechanic of the Dubuque-Illinois and Kansas City division, with headquarters at Savanna, on July 1, 1943.

Car Department

E. W. Pearson, who has been appointed mechanical engineer (car) of the Canadian National at Montreal, Que., as noted in the October issue, is a native of Hull, England. He entered railroad service

E. W. Pearson

in October, 1910, as a draftsman in the mechanical department of the Canadian Northern (now Canadian National) at Winnipeg, Man. In 1916 he was transferred to Toronto, Ont., and in March, 1919, was appointed acting chief draftsman. Mr. Pearson was appointed assistant chief draftsman of the Canadian National at Montreal in 1923, shortly after the re-organization of that road.

Shop and Enginehouse

C. R. Kilbury, master mechanic of the Omaha-Northern Kansas and Kansas City Terminal divisions of the Missouri Pacific, has been appointed superintendent of shops, with headquarters at Sedalia, Mo.

Walter H. Ohnesorge, whose appointment as superintendent of the locomotive repair shops of the Boston & Maine at North Billerica, Mass., was noted in the August issue, was born on July 12, 1885, at Dubuque, Iowa. He attended high school and obtained further education through the International Correspondence Schools and at the Harvard School of Transportation. He became a machinist apprentice in the employ of the Chicago, Milwaukee & St. Paul on August 21, 1902. After serving his apprenticeship he was employed in the shops of the Chicago Great Western at

W. H. Ohnesorge

Oelwein, Iowa. Mr. Ohnesorge then worked on various other railroads throughout the country, including "Old Mexico." He returned to the Chicago, Milwaukee & St. Paul in October, 1908, as a machinist and worked at Dubuque, Iowa, and North McGregor. He became a machinist in the employ of the Northern Pacific at Livingston, Mont., in July, 1912. In July, 1913, he again entered the service of the Chicago, Milwaukee & St. Paul as a machinist at Seattle, Wash. In 1916 he became foreman and general foreman, serving successively at Cedar Falls, Wash.; Othello; Miles City, Mont., and Austin, Minn. He became general foreman of the Western Maryland at Cumberland, Md., in January, 1924. From September 1, 1925, until March 1, 1926, he was employed by the Boston & Maine at Westboro, N. H. On the latter date he was transferred to Mechanicville, Me., as general foreman, and on February 21, 1927, was appointed master mechanic. He became general inspector of locomotive maintenance, with headquarters at Boston, Mass. on January 1, 1929, and general foreman at Billerica on August 16, 1933; assistant shop superintendent on July 1, 1941, and shop superintendent on July 1, 1943.

Obituary

Charles Hepburn Andrus, at one time a master mechanic on the Pennsylvania Railroad, died at Sinking Springs, Pa., August 23, 1943. Mr. Andrus was born at Williamsport, Pa., September 7, 1864, and entered Pennsylvania Railroad service June 1, 1875, as a messenger on what is now known as the Williamsport division. He served continuously on that road in the following capacities: 1880, machine apprentice, Middle division; 1884, machinist and then fireman, Philadelphia division; 1888, engineman, Schuylkill (now Wilkes-Barre) division; 1899, road foreman of engines, Schuylkill division; 1903, general foreman, motive power department, Philadelphia division; 1904, general foreman, Philadelphia Terminal division; 1906, locomotive inspector; 1913, master mechanic, Philadelphia division; 1916, master mechanic, Renovo division; 1919, shop inspector, Williamsport division; 1920, shop inspector, Sunbury division; 1921, engineman, Schuylkill division. Mr. Andrus retired in 1929 because of impaired eyesight.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

Pipe Tools.—Beaver Pipe Tools, 300-400 Dana avenue, Warren, Ohio. Catalog No. 44, 48 pages illustrated. Beaver pipe tools—beveling tools, pipe cutters, electric pipe and bolt machines, grooving tools, threaders, etc. Prices given.

◆

Tantung Tools.—The Vascoloy-Ramet Corporation, North Chicago, Ill. Attractive 24-page catalog. Contains dimensions and list prices of various Tantung tools, and information on how to grind and how to braze Tantung, as well as performance data showing the results obtained by its use in various machining operations.

◆

Brake-Beam Support.—Grip Nut Company, Chicago. Four-page illustrated bulletin entitled "Universal Brake Beam Safety Support Adjustable." Describes the support and its operating advantages. A 17-in. by 24-in. wall chart which gives illustrated instructions for the proper installation and maintenance of the brake-beam support is also available.

◆

"How to Maintain Electric Equipment."—General Electric Company, Schenectady, N. Y. A 372-page, 8-in. by 10-in. illustrated book, bound in stiff covers. Price, $1.75. Includes 21 chapters on how to maintain battery trucks, bushings, cable and wire, capacitors, industrial Diesel-electric locomotives, electric furnaces, fuse cutouts, industrial control, electronic control instruments, lighting equipment, lighting arresters, midget heaters, mine locomotives, motors and generators, rectifiers, regulators, switchgear, turbines and welders, and on how to use insulating varnishes and compounds. As an example, the chapter on how to maintain rectifiers includes general information, a preventive maintenance schedule, data on how to detect misfires, how to detect a faulty rectifier, how to remove an ignitor, how to clean tanks, corrosion prevention in cooling systems and a trouble-shooting chart. Three additional chapters contain technical data including treatment for electric shock and information on renewal parts and General Electric service shops.